

# 소개글

## **Use of Data in Design**

디자인에서의 데이터의 활용

## **DISCRETIZATION for SPATIAL INFORMATION & CODIFICATION of DESIGN(DECISION-MAKING PROCESS) and METHODOLOGY**

공간정보의 이산화 & 디자인 프로세스의 코드화

### **“데이터” 기반 사회**

오늘날 우리는 인공지능, 자율주행, 로보틱스, 스마트시티, 디지털 트윈, 메타버스 등과 같은 혁신적인 기술들은 주도하는 시대를 살아가고 있다. 이러한 산업들은 걸으로는 서로 다른 형태를 보이지만, 그 본질을 보면 모두 데이터의 수집, 가공, 분석을 통해 기존 산업을 증강, 혁신하고 새로운 가치를 창출하는 데이터 중심의 패러다임을 공유하고 있다. 데이터 기반 사회로의 전환은 기존 산업에서 데이터 활용을 체계적, 명시적으로 도입함으로써, 더욱 높은 정밀도와 해상도로 기존의 산업을 발전시키며 다양한 용합을 촉진하고 있다. 이러한 근본적인 변화 속에서 디자인 산업은 어떤 진화를 겪으며 디자이너들에게 어떤 준비와 역량이 요구될까?

### **“디자인 재료”로써의 “데이터”**

역사적으로 새로운 재료의 등장은 항상 혁신적인 도구의 소개, 발전을 동반했으며, 다양한 가능성을 드러내며, 디자인 산업 진화의 촉매 역할을 해오고 있다. 특히 데이터라는 재료는 코드라는 도구를 통해 가공되며, 디자인 전 과정을 포함한 유지 관리에 걸쳐 그 데이터의 흐름을 씨줄과 날줄로 역음으로서 정보 기반으로 디자인 프로세스를 구체적이고 명시적으로 코드화할 수 있게 된다. 데이터는 디자인 산업에 혁신적 변화를 가져오는 방식과, 디자이너가 새로운 가능성과 창의성을 탐구할 수 있는 새로운 사고의 틀을 열어 주고 있다.

### **공간정보의 “이산화” 그리고 프로세스의 “코드화”**

이번 발표에서는 디자인 요소와 과정을 코드화하여 이를 가공하고 활용하는 환경에 대해 이야기할 것이다. 특히, “현실 정보의 데이터화”, “디자인 프로세스의 코드화”와 “모델화”를 통해 정보들을 명시적으로 다루는 과정을 소개할 것이다. 다양한 실험과 분석, 피드백을 통해 디자이너가 효과적이고, 통합적이며, 창의적인

the use of data in design

# 디자인에서 데이터의 활용



# DESIGNER & SOFTWARE ENGINEER & EDUCATOR



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Director and founder of

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# NJSTUDIO & NJSLAB

Since 2004

Hello there :) Very welcome to NJS Lab!!

NJSLAB: NJSTUDIO LABORATORY FOR

DATA, AI, COMPUTATION, & VISUALIZATION  
FOR DESIGN

**!Software Technology for Design**

<https://namjulee.github.io/njs-lab-public/>

# INDUSTRY & ACADEMIA



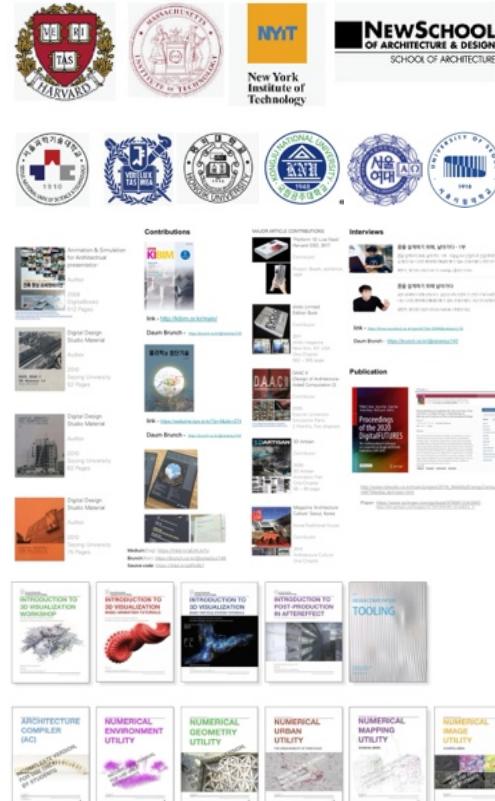
NJSTUDIO &  
NJSLAB

# INDUSTRY & ACADEMIA

The screenshot shows a website header with links for index, NJ Namju Lee, NJS Lab, Code for Design, and Link & Legacy. A dropdown menu is open under 'Code for Design' with options: Course, Teaching, Writing, and Code for Design. Below the menu is a search bar with the placeholder 'searching by keywords'.

1,300 여 개의 영상 (강의 & 워크숍 & 상담 & 커리어전략),  
150 여 개의 글(칼럼, 기고, 연구, 논문, 2권의 책), 140 여 개  
의 직/간접적은 프로젝트, 연구, 개발, 340 여 개의 워크숍 자  
료, 46 여 개의 수업들을 통해, 디자인과 컴퓨테이션 학습, 연  
구, 활용에 대한 지식과 경험을 나누고, 산업의 전문가/프런티  
어로서 그 역할을 충실히 해오고 있습니다. (2024년 9월 기

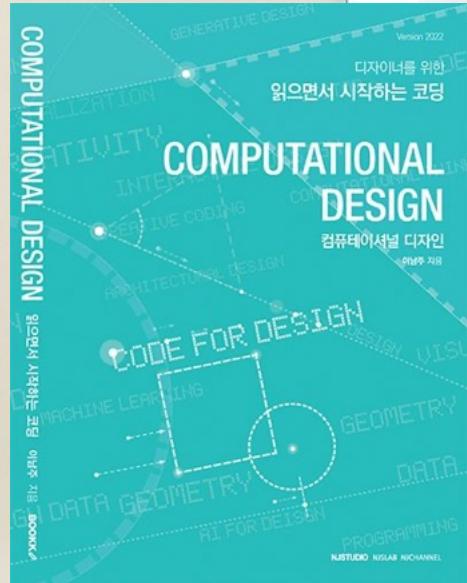
준: 조회수 453,616명, 조회시간 25,200시간 / 1,050일)



읽으면서 시작하는

디자이너를 위한 코딩

## Computational Design



읽으면서 시작하는 디자이너를 위한 코딩

Computational Design

### ! 언어와 사고의 도약

우리는 무엇을 배우면서 사는가? : 세대에 따른 언어, 지능, 그리고 도약들

#### 구어체

언 과도 비슷하지만 가깝게 6.25 전쟁을 겪으신 우리 할머니, 할아버지 시대에는 대부분의 사람들이 학교에서 언어(국어, 수학, 과학, 경제, 문화 등)을 학습하기보다, 전쟁으로 무너진 나라를 일으키기 위해 삶의 현장과 일터에서 대부분의 삶을 보냈죠.

즉, 그들의 소통, 기록, 학습에 사용되는 주요 언어의 형식은 구어체로 볼 수 있어요. 당시에는 글을 읽고 쓸 수 있는 분들이 많지 않았고, 지금과 비교해 보면 정보 매체 또한 다양하지 못했죠. 따라서 말과 말을 통해 습득된 지식과 경험의 이해는 상대적으로 해석되고, 정보 전달에 많은 노이즈와 와곡이 편안할 수밖에 없는 시대로 볼 수 있죠. 이러한 문화, 시대정신, 사고체계가 그 시대의 인텔리전스로 남았던 것이죠.

#### 문자체

경제가 발전하면서 교육 수준과 열의가 높아지며 새로운 세대가 나타나기 시작했죠. 대부분의 사람들이 고등학교까지 의무 교육을 보편적으로 이수하며 문맹률은 낮아졌고, 보다 많은 사람들이 다양한 언어들을 높은 수준으로 이해하며 지식과 학습의 폭을 넓힐 수 있었죠.

과거 구어체를 사용하는 것보다 문자체를 활용하는 것이 지식과 본질을 이해하고, 학습하고, 삶에 적용함을 더 용이하게 했다고 볼 수 있죠. 경제발전에 따라 변화하는 새로운 사회 요구를 없이 무리 없이 학습의 능력이 도약한 시기로 볼 수 있어요.

#### 논리체계

2000년도를 넘어가며, 대학교에서는 또 한 번의 혁신이 일어나기 시작죠. 시

에 요구되는 보편적 언어와 지식을 넘어, 전공지식 언어를 습득하여 보다 전문화, 체계화된 지식들과 논리체계는, 분명 기초지식만을 학습하는 시대보다 더 높은 수준의 사고를 원활히 할 수 있는 세대로 정리될 수 있죠.

우리가 살고 있는 지금이, 과거 그 어느 때보다 복잡한 정보와 문제를 다각도로 사고하고 결정을 내릴 수 있는 시대가 아닐까 생각해 봄요. 인터넷의 발달로, 굉장히 높은 수준의 정보를 과거보다 손쉽게 접근할 수 있을 뿐 아니라, 그 지식을 소화할 수 있는 논리체계도 활동해졌다고 볼 수 있어요.

#### 정보 보존과 전달 그리고 업그레이드

분명 과거보다 지식수준은 높아졌고, 정보의 손실을 최소화하여, 그 지식을 프로세스화할 수 있는 사고체계 또한 다양해지고, 전문화된 사고 방법론들도 보다 엄밀히, 과거에는 포착조차 못한 부분들도 사고의 대상으로 둘 수 있는, 높은 수준의 개개인의 지능이 과거에 비해 비약적으로 도약하며 또 한 세대를 정의했다고 볼 수 있어요.

또 한 번의 도약은 어디서 일어나고 있을까요? 적금의 시대를 바꾸고 이끌어가는 핵심 영역들에서 우리가 습득할 수 있는 언어와 논리체계는 무엇일까요?  
어떤 사고의 힘이 사회의 지능을 또 한 번 도약시킬까요? 필자의 개인적인 생각은 QR 코드 [컴퓨테이셔널 디자인 37. 우리는 무엇을 배우면서 사는가? feat. 언어와 이셔널 사고, 그리고 사고의 도약]을 통해 더 자세히 공유할게요.



[컴퓨테이셔널 디자인] 37. 우리는 무엇을 배우면서 사는가? feat. 언어와 컴퓨터이셔널 사고, 그리고 사고의 도약]

Daum Brunch - <https://brunch.co.kr/@njinamju/144>

Book - <https://www.bookk.co.kr/book/view/130128>

EBook - <https://www.upaper.net/njinamju/1148626>

Audio book - <https://www.youtube.com/playlist?list=PLweNVwGpOKEmUTBw-PFjQzOk3Lwq83>

the use of data in design

# 디자인에서 데이터의 활용

# DISCRETIZATION for SPATIAL INFORMATION & CODIFICATION of DESIGN<sub>(DECISION-MAKING PROCESS)</sub> and METHODOLOGY

## 공간정보의 이산화 & 디자인 프로세스의 코드화

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TOC

**1. DATA & DESIGN**

**2. VECTOR & RASTER**

**3. CASE STUDY**

**4. LEARNING MATERIAL**

AlphaGo, Demis Hassabis, 2015



## New era of technology, design

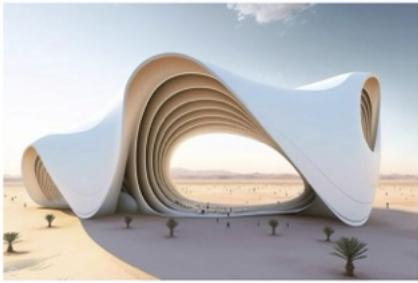


Théâtre D'opéra Spatial (Space Opera Theater)

Ref: Midjourney



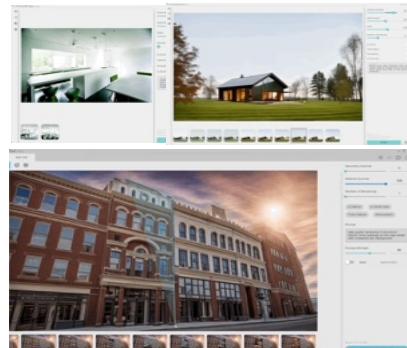
By Stanislas Chaillou



Written by Kaley Overstreet

Published on May 02, 2023

"Can you help me design my residential tower? It's 30 stories and located in Brooklyn, New York." ChatGPT's response may be surprising. Given that the bot has no architectural experience, and is certainly not a licensed architect, it was quick to rattle off a list of considerations for my building. Zoning codes, floor plan functionality, building codes, materiality, structural design, amenity spaces, and sustainable measures were just a few of the topics ChatGPT shared information about.



Veras



Prompt: A stylish woman walks down a Tokyo street filled with warm glowing neon and animated city signage. She wears a black leather jacket, a long red dress, and black boots, and carries a black purse. She wears sunglasses and red lipstick. She walks confidently and casually. The street is damp and reflective, creating a mirror effect of the colorful lights. Many pedestrians walk about.more

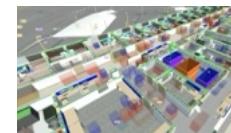
ARUP



By Heechan Shin



Adobe



4th industrial revolution

BIM, Smart City, Digital Twin ...

AI, Machine Learning, LLM, Parallel Computing, Edge Computing ...

Drone, Autonomous Vehicle ...

4th industrial revolution

BIM, Smart City, Digital Twin ...

AI, Machine Learning, LLM, Parallel Computing, Edge Computing ...

Drone, Autonomous Vehicle ...

**Data**

## **Materials and Tools for Design**

Stone, Glass, Plastic, Iron, Concrete ...

## **Materials and Tools for Design**

Stone, Glass, Plastic, Iron, Concret ...

**Data**

# DATA at

geometry

architecture

urban

landscape

computation

visualization

material

GIS

Interaction

building energy

fabrication

...

Quantitative & Qualitative

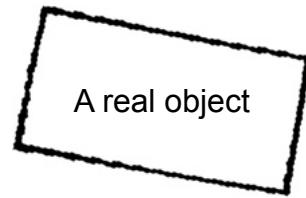
# DATA

Vector

&

Raster

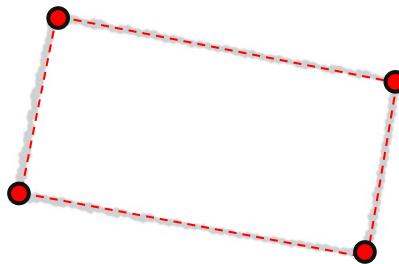
## Vectorization & Rasterization



**Vector**

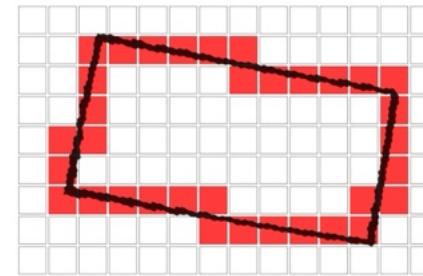
&

**Raster**



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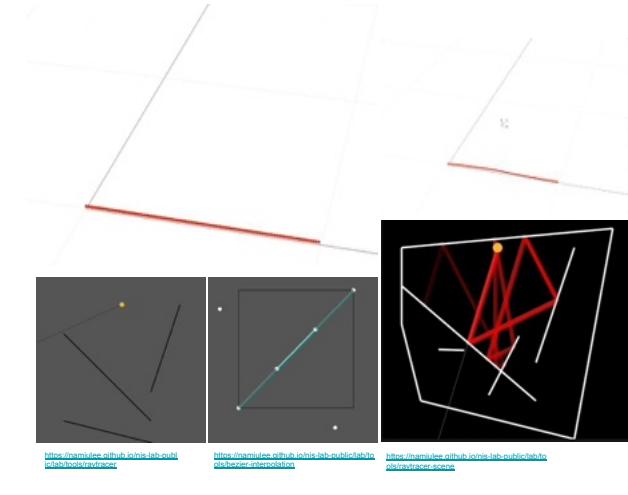
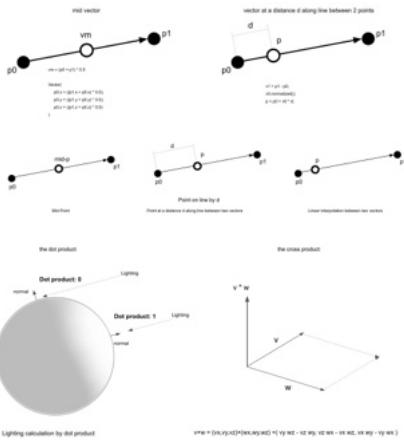
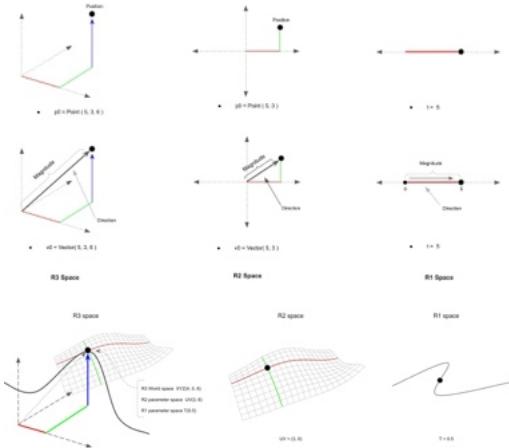
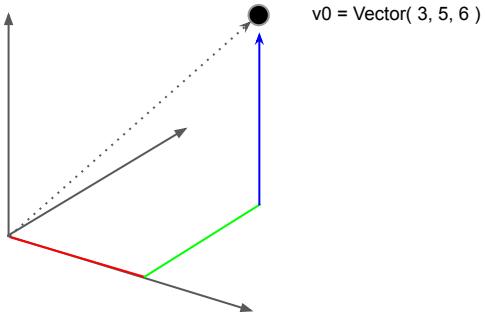
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```

# Vector

Cartesian (Euclidean) Plane R3



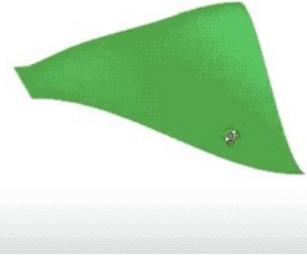
<https://namilee.github.io/njs-lab-public/work?id=2015-nqu-development>

Geometry, Addon for Grasshopper

<https://www.food4rhino.com/app/numerical-geometry-utility>

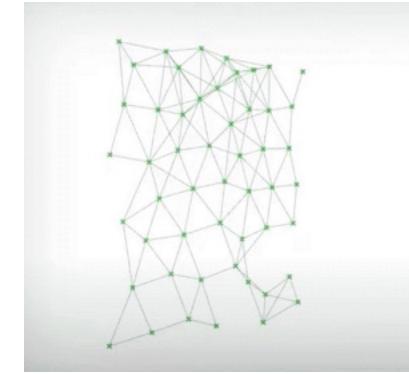
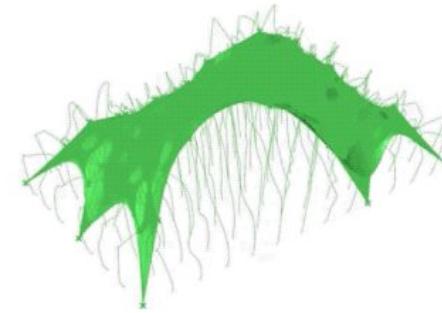
Dynamics, Addon for Grasshopper

<https://www.food4rhino.com/app/numerical-mapping-utility>

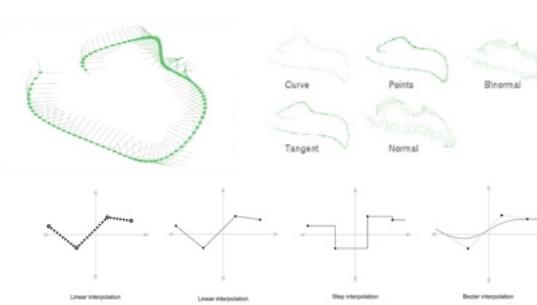
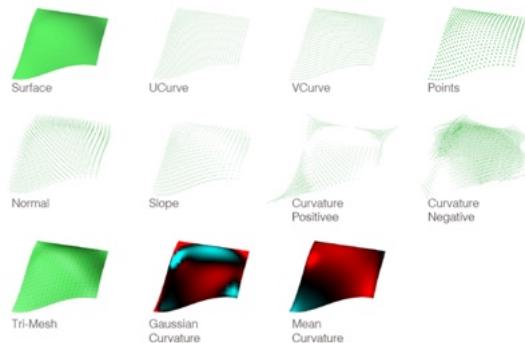


## Geometry as Data Structure [link](#)

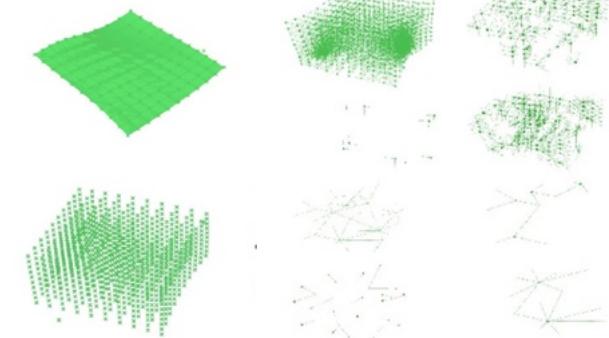
DYNAMICS

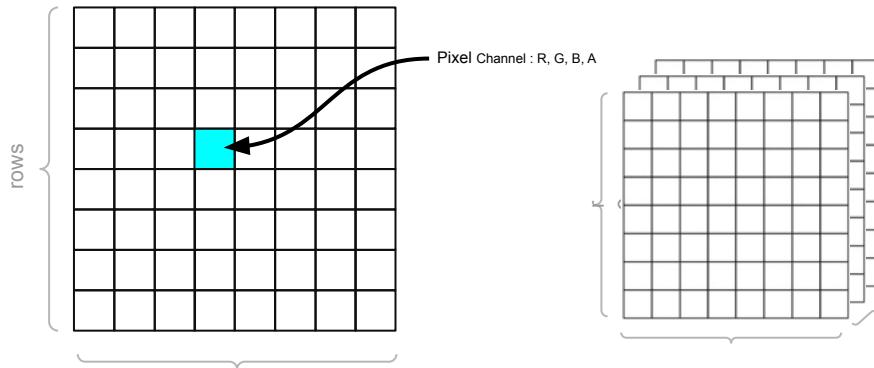


### Data extractions



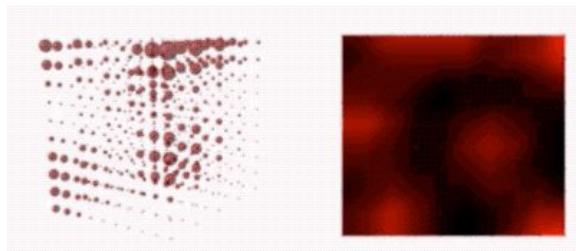
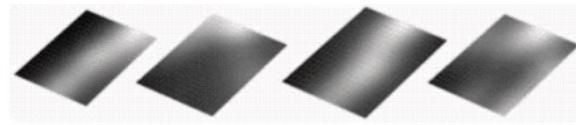
### Connectivity



**Raster**

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**Voxel Structure****Layers**

numerical descriptions as design tools

data structure

graph

pixel

voxel

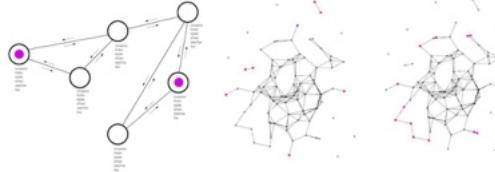
...

# DATA STRUCTURE METHODOLOGY

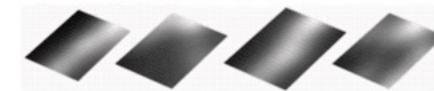
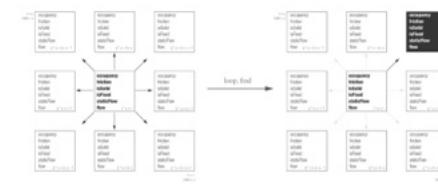
Data Structure and Algorithm for Design and Research Workshop

Type of Abstraction & Discretization & Resolution

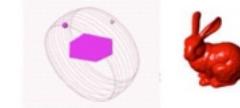
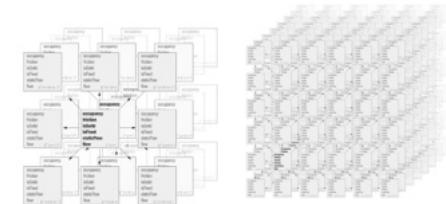
**Graph** [link](#)



**Pixel** [link](#)



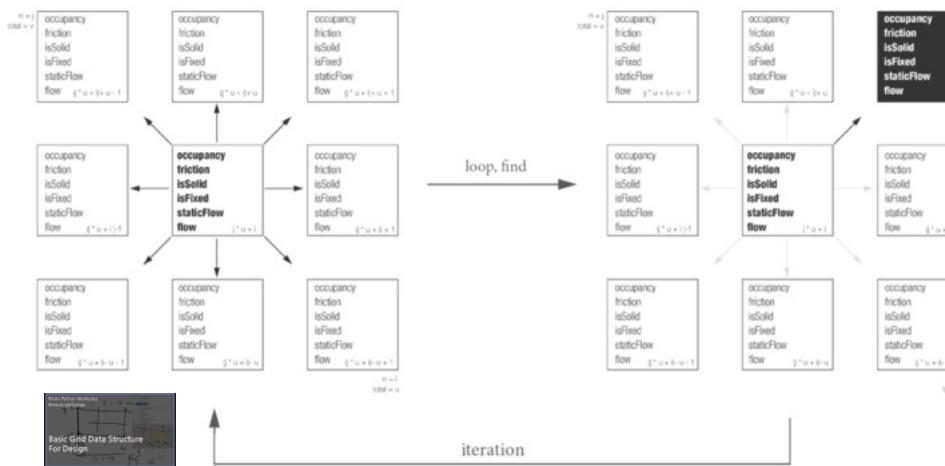
**Voxel** [link](#)



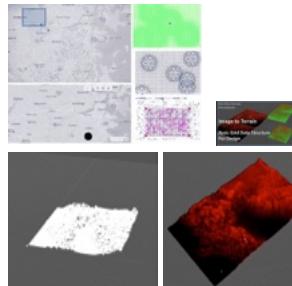
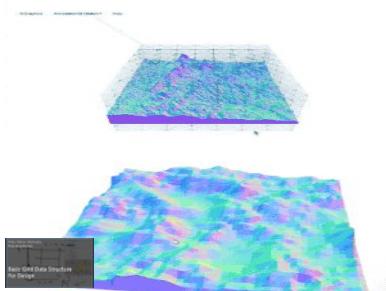


**Raster Data Structure**

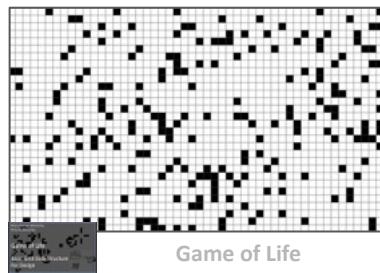
# Grid System



## Grid Mesh

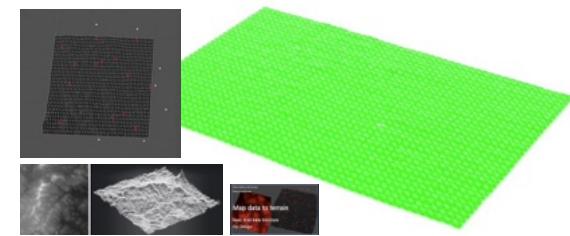


## Connectivity

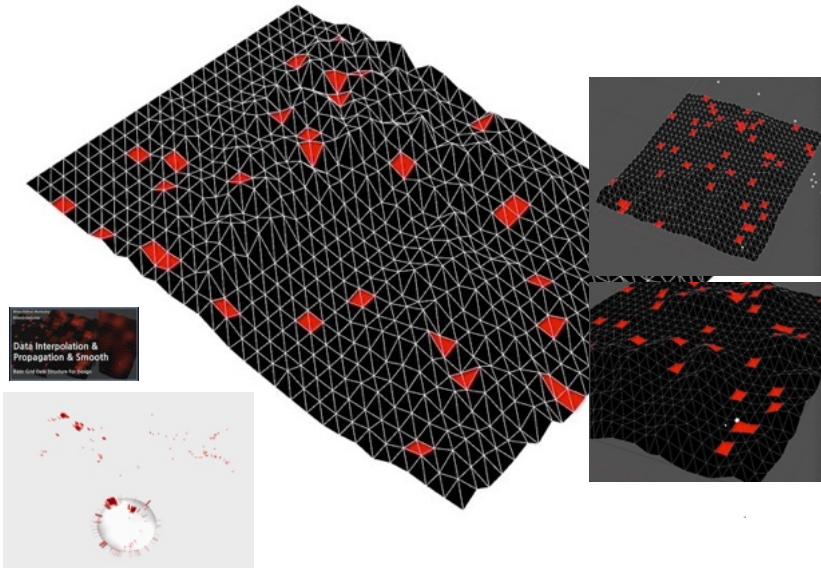


Game of Life

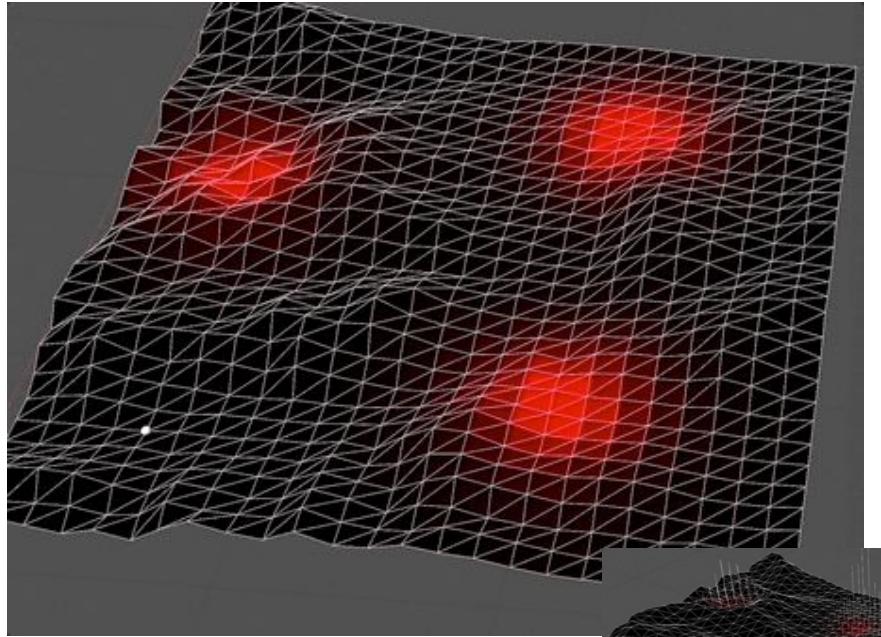
## Data to Terrain



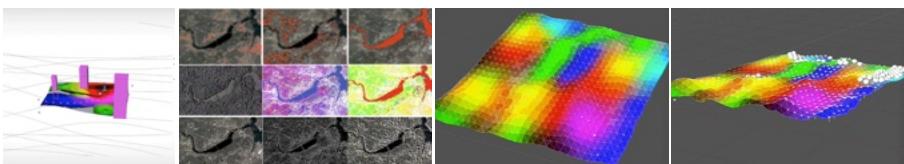
## Propagation

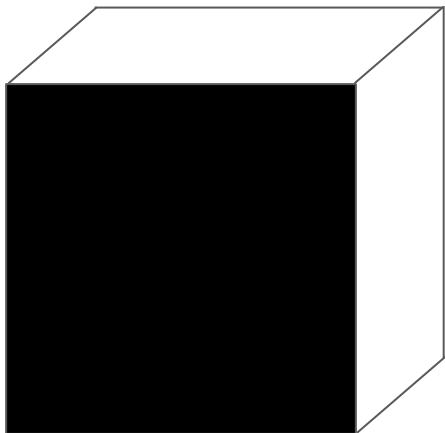


## Data Falloff &amp; Smooth



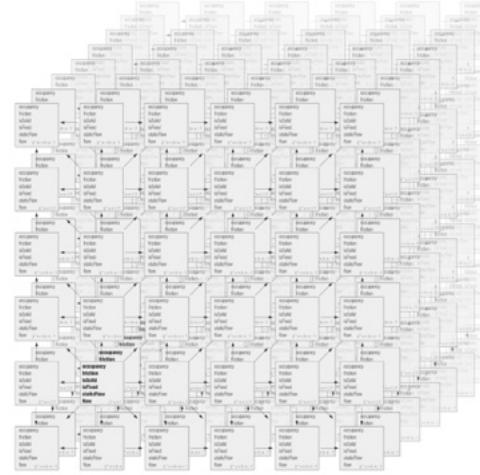
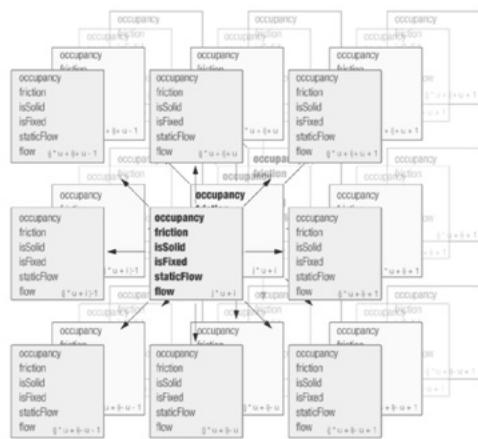
## Data Channels



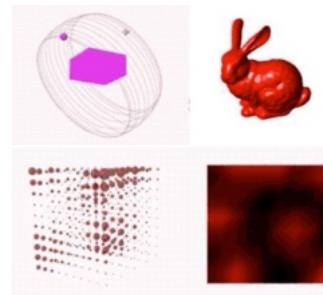
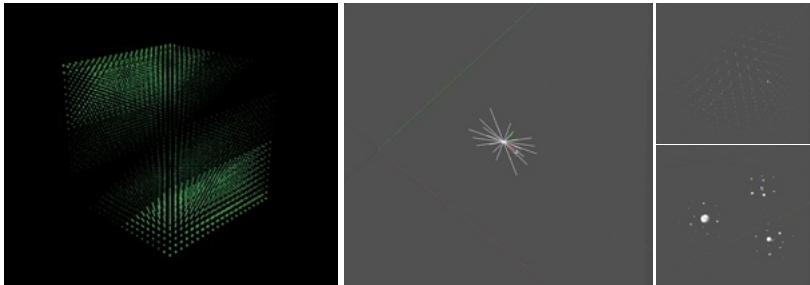


**Voxel Map Data Structure**

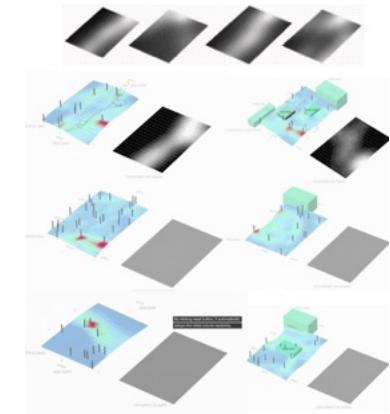
# Voxel



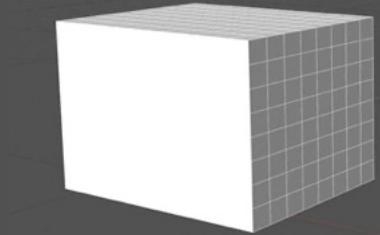
Connectivity



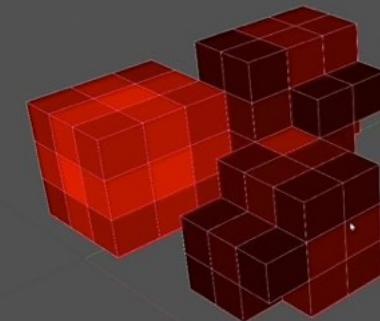
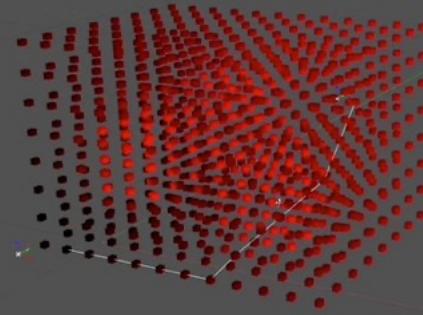
Data Interpolation



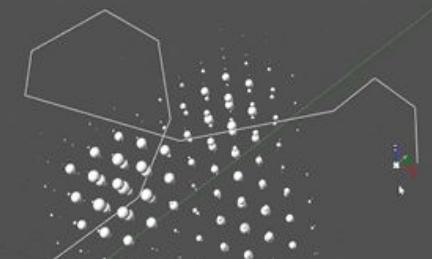
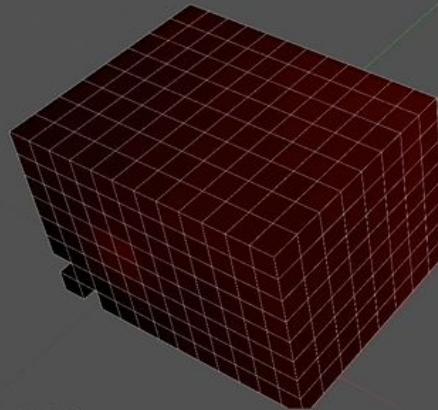
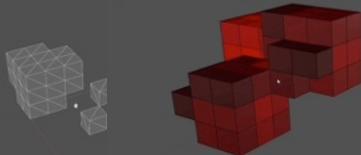
Voxel Data Visualization



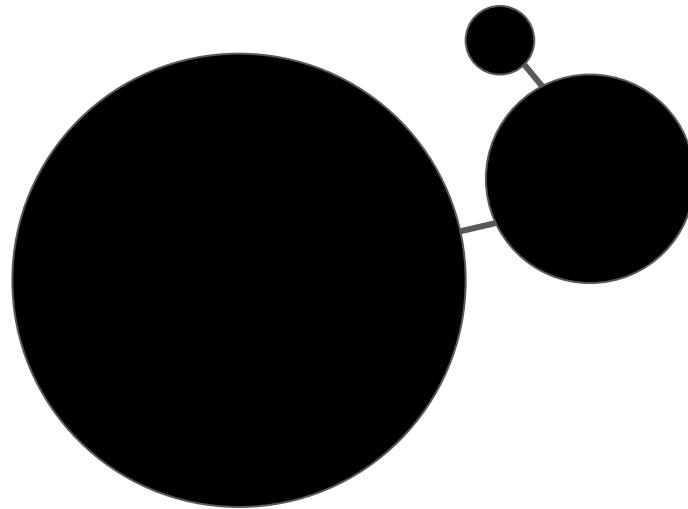
Voxel, Path Finding



Voxel Mesh

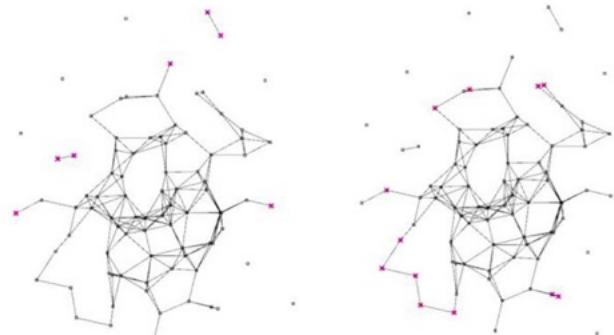
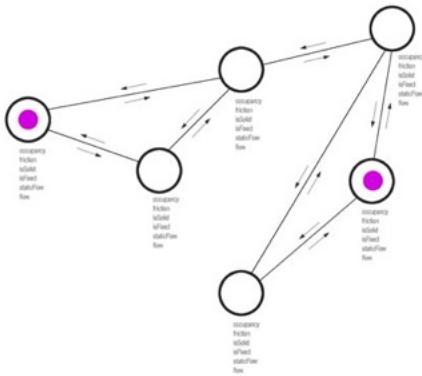


Front Top Front Right



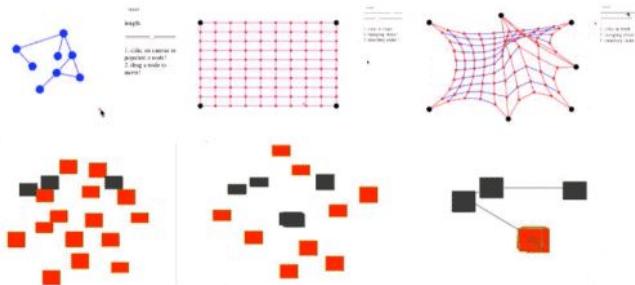
**Graph Data Structure** [link](#)

# Graph



## Graph Analysis

DYNAMICS



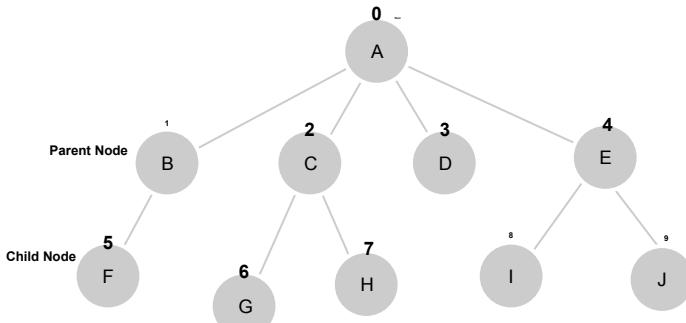
## Network Analysis

DYNAMICS



# Graph & Pixel & Voxel

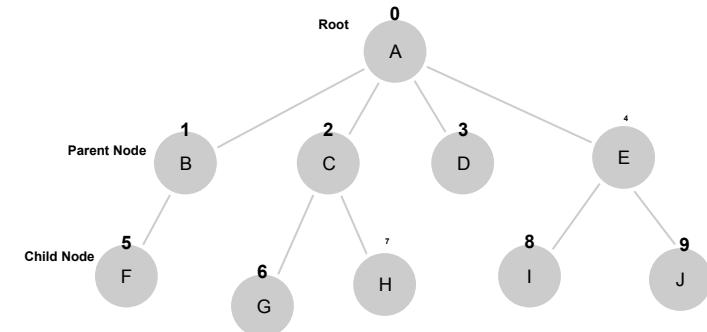
## Search & traversal



DFS  
Depth First Search Using a Stack

0,1,5,2,6,7,3,4,8,9

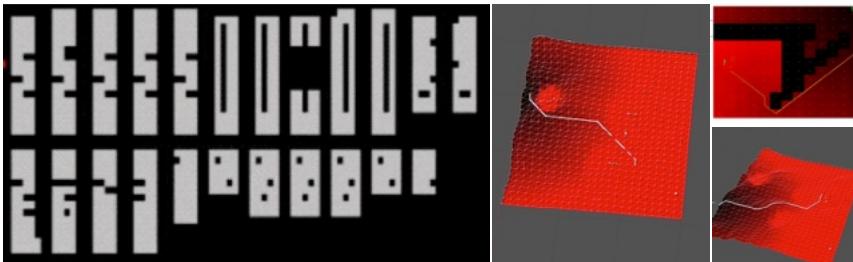
Reference:  
<https://codepen.io/NJStudio/pen/RwWxGXo?editors=1011>



BFS  
Breadth First Search Using a Stack

0,1,2,3,4,5,6,7,8,9

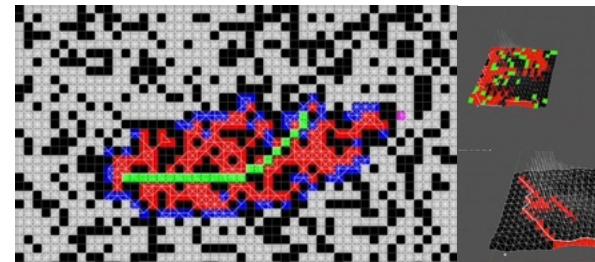
Path Finding & Dijkstra



Reference:  
[https://docs.google.com/presentation/d/1TjPQ0E-dP1JnfmEBzGzYxTHk8c9WE1PBShH2PWshW3Uj/edit#slide=id.g1b82a001364\\_0\\_288](https://docs.google.com/presentation/d/1TjPQ0E-dP1JnfmEBzGzYxTHk8c9WE1PBShH2PWshW3Uj/edit#slide=id.g1b82a001364_0_288)

<https://codepen.io/NJStudio/pen/RwWxGXo?editors=1011>

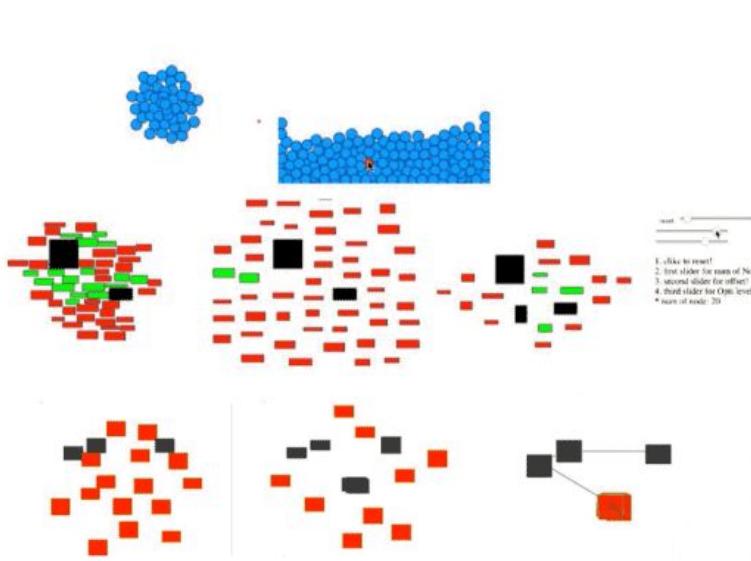
PathFinding A\* concept



<http://theory.stanford.edu/~amitp/GameProgramming/Heuristics.html>

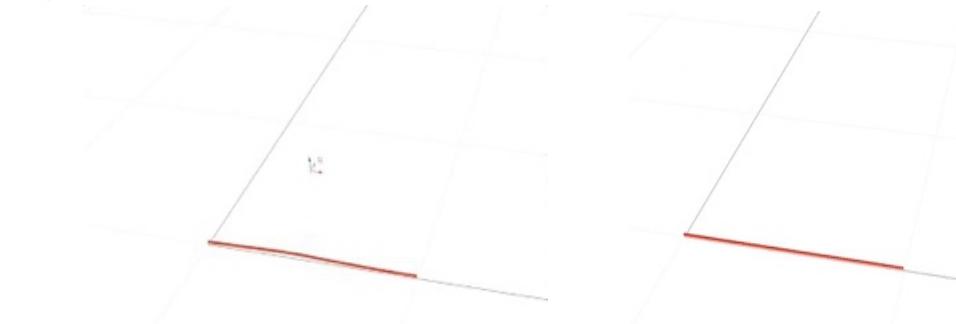
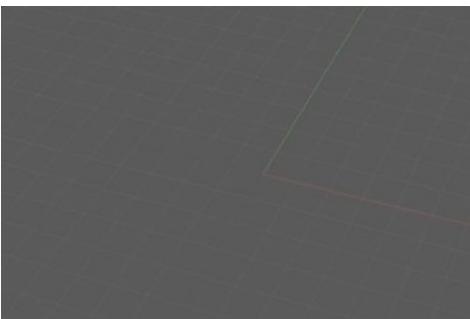
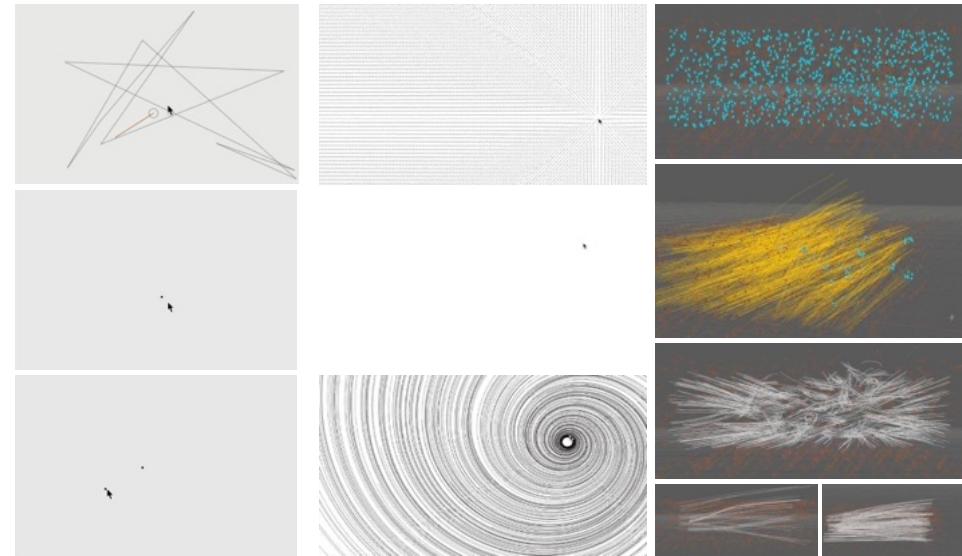
# Particle

DYNAMICS



# Field & Particle

DYNAMICS



# SYSTEM FOR DESIGN

Translating information to insights for design decisions

Parametric, algorithmic design

Optimization & Automation

Agent-Based / multi agent based design system

Rule-Based & Generative Design System

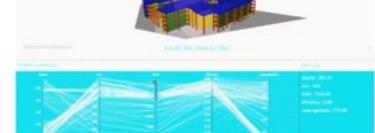
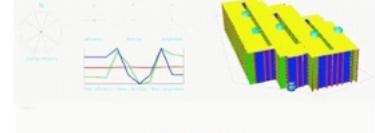
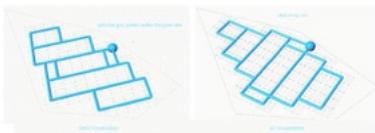
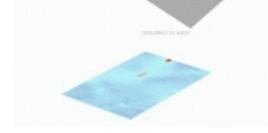
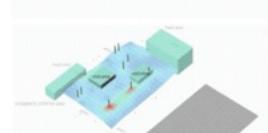
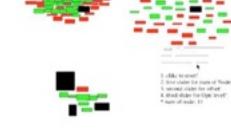
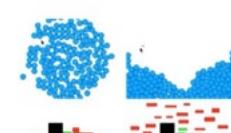
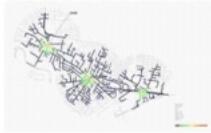
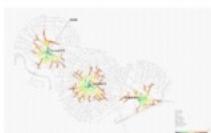
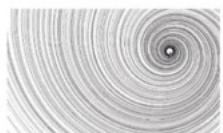
Interaction in design

Data driven decision making process

Complex system in design

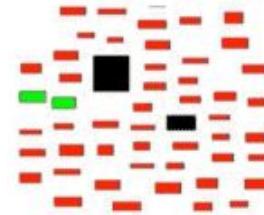
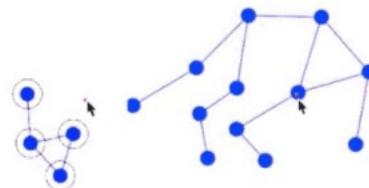
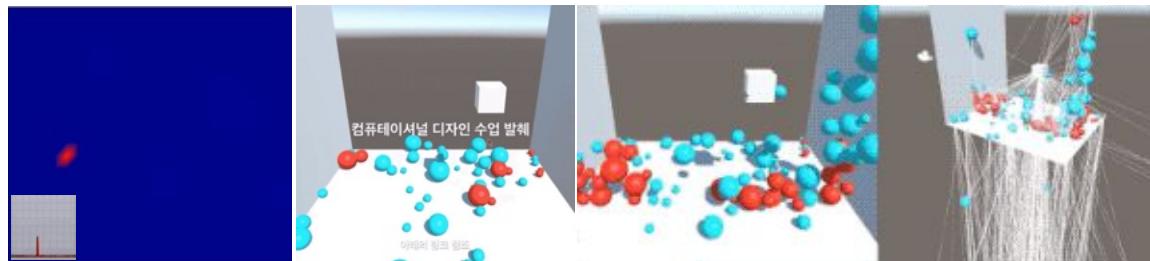
AI / ML / LLM / Generative model

BIM / BAM



Connectivity:

# Dependency & Hierarchy & Relationship [link](#)



# COMPUTATIONAL THINKING

[link](#)

Problem solving & From implicit to explicit - 쉬운설명 <https://brunch.co.kr/@minamiu/1>

1.1. 암묵적(Implicit)에서 명시적(Explicit)로 - 분해(Breakdown), 추상화(Abstraction), 패턴(Pattern)

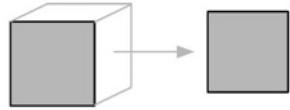
1.2. 변수(Variable) / 파라미터(Parameter)

1.3. 모듈(Module)의 재활용성(reusable)

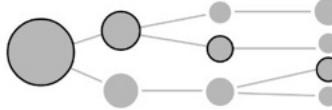
1.4. 수 체계 -

1.5.. 프로그래밍 패러다임 ([Programming paradigm](#))

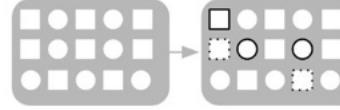
1.6. 전공 영역(Domain)



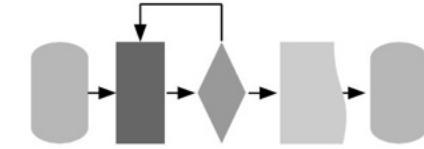
Abstraction



Decomposition



Pattern Recognition



Algorithms

! 컴퓨터이서널 사고(Computational Thinking) 그리고 컴퓨터이서널 디자인(Computational Design) - [link](#)

QnA 102 컴퓨터이서널 디자인 프로젝트 피드백 & 컴퓨터이서널 디자인 사고 - [link](#)

QnA 95 컴퓨터이서널 사고 / 기본법적 접근 방지 / 문제 해결 방법 - [link](#)

QnA 94 컴퓨팅오류스러워, 재활용 디자인 학부생과 대화 그리고 컴퓨터이서널 디자인 - [link](#)

QnA 93 컴퓨팅오류스러워 - 디자인, 알고리즘, 학습방법, 기술과 디자인을 풀면 - [link](#)

QnA 85. 건축학과2학년의질문, 컴퓨터이서널디자인에아떻게, 이해하고, 공부하고, 적용할까? - [link](#)

QnA 84. 건축학과2학년의질문, 컴퓨터이서널디자인에아떻게, 이해하고, 공부하고, 적용할까? - [link](#)

S.A.7.0 Lecture 2. 디자인을 위한 컴퓨터이서널 사고 / Computational Thinking For Designer - [link](#)

컴퓨팅이서널디자인 38] 4.6 학습 내용과 방향 (디자인자를 위한 컴퓨터이서널 디자인 특강 2021) - [link](#)

QnA 61 컴퓨터이서널디자인 교육, 코딩 교육, 누가 가르쳐야 하나 - [link](#)

QnA 59. 가장 일반적인 오류, 컴퓨터이서널 디자인 오류들 - [link](#)

QnA 58. 건축 컴퓨터이서널 디자인 활용? 응용방법?, 일반의 사고방식? - [link](#)

...

여기 [QnA](#) 카드에 가서는 Ctrl + F를 활용해서 키워드로 검색하시면 더 많은 자료를 찾을 수 있어요!

## Design & Computation



**from function to result**

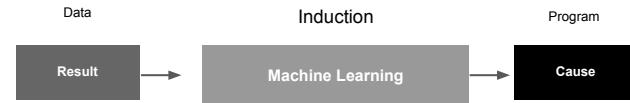
**VS**

**from result to function**



Traditional Programming, Software 1.0 [link](#)

$$3 + 3 = ?$$



Machine Learning, Software 2.0 [link](#)

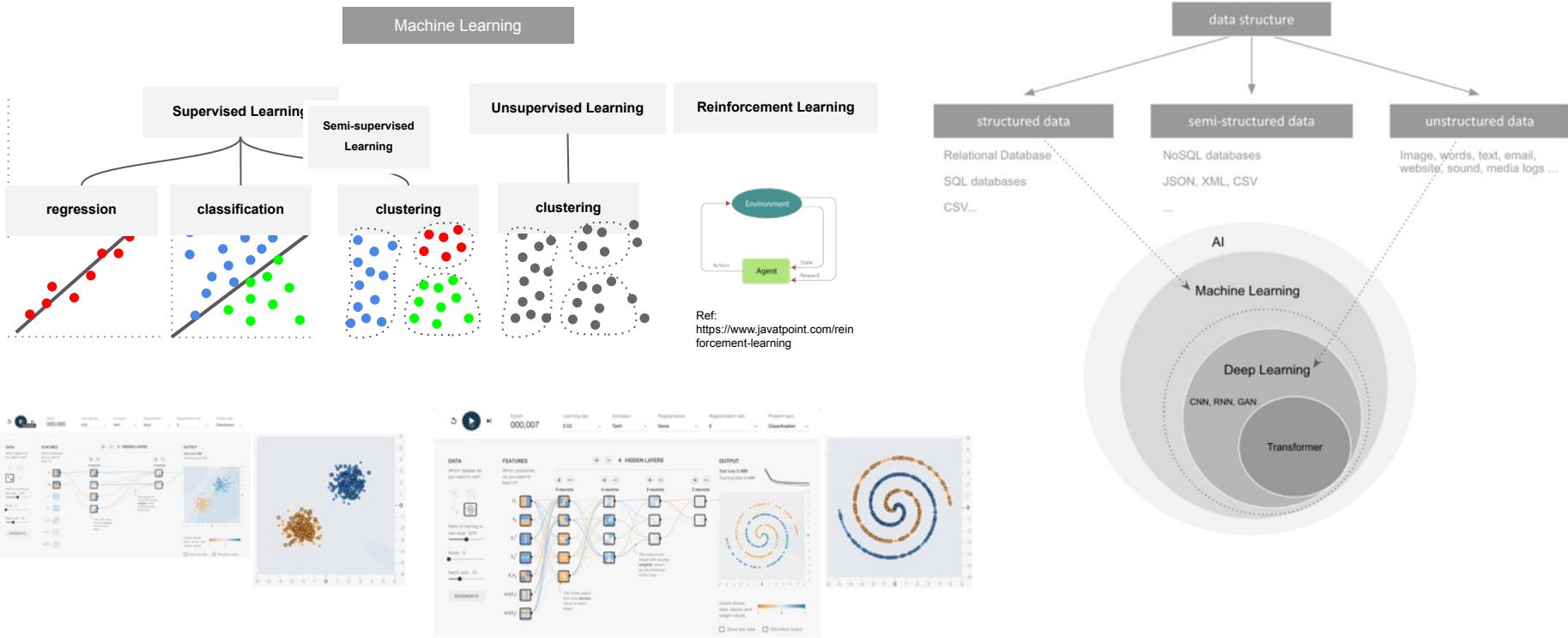
$$3 ? 3 = 6$$

[Inductive learning \(귀납적 학습/프로그래밍 \) link](#)

# AI & Machine Learning

Machine Learning is used to transform the **structure** or **type** of data,

when we don't know to program it directly.



# Issue & methodology

## Analytical AI

VS

## Generative AI

**Analyzes** data to derive insights, identify patterns, make predictions, or inform decision-making.

### Methodology

Statistical models; Machine learning algorithms, and data analytics techniques

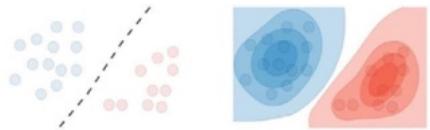
**Creates** new content; videos, images, text, or audio, by learning from existing patterns in data.

### Methodology

Generative Adversarial Networks (GANs) or Transformer models (Generative Pre-trained Transformer:GPT)

# Machine Learning

## Supervised Learning



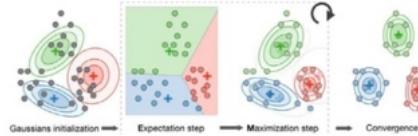
### Discriminative model

Decision Boundary  
Regressions, SVMs

### Generative model

Probability distributions of the data  
GDA(Gaussian Discriminant Analysis), Naive Bayes

## Unsupervised Learning



### Clustering:

K-means clustering, Hierarchical clustering

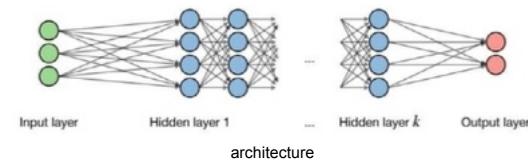
### Dimension reduction:

PCA (Principal Component Analysis), ICA(Independent component analysis)

### Nonlinear dimensionality reduction:

t-SNE(t-distributed stochastic neighbor embedding)

## Deep Learning

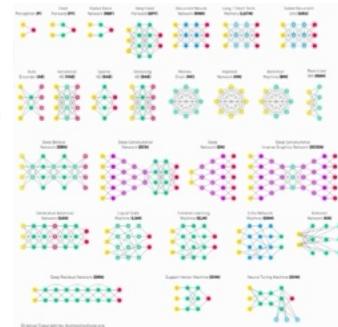


**CNN** (Convolutional Neural Networks)  
**RNN** (Recurrent Neural Networks)  
**RL** (Reinforcement Learning)

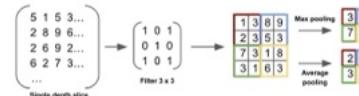
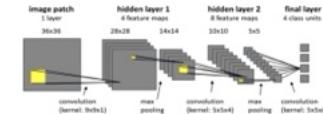
Reference: CS229 - Machine Learning, Stanford University

## Neural networks basic architectures

- Backfed Input Cell
- Input Cell
- Noisy Input Cell
- Hidden Cell
- Probabilistic Hidden Cell
- Spiking Hidden Cell
- Output Cell
- Match Input Output Cell
- Recurrent Cell
- Memory Cell
- Different Memory Cell
- Kernel
- Convolutional or Pool



## Convolutional Neural Network



Sigmoid	Tanh	ReLU	Leaky ReLU
$g(z) = \frac{1}{1 + e^{-z}}$	$g(z) = e^z - e^{-z}$	$g(z) = \max(0, z)$	$g(z) = \max(z, \alpha z)$ with $\alpha < 0$

Reference:  
CS229 - Machine Learning, Stanford University  
<https://www.asimovinstitute.org/>

# Codification of the design process

## Computational Design Thinking

Writing, Medium - <https://hi-nsmu.medium.com/computational-design-thinking-for-designers-882248407fc>

Lecture Video - <https://youtu.be/oGSrqYqEm8>

1. Question
2. Methodology & Approach
3. Policy
4. Implementation : algorithm

## 디자이너를 위한 컴퓨터이서널 티킹 / Computational Thinking For Designers

01:02 - 언어를 통일 하자  
01:53 - 가장 중요한 것은? Questions / Imaginations / Hypothesis  
05:04 - 시작 전 우리의 자세는? Methodology / Approach  
06:50 - 과정에서의 전략은? Manifesto / Policy  
09:30 - 결정론? 확률론? Deterministic / Stochastic  
10:00 - 확장할 것인가? 집중할 것인가? Converge / Diverge  
13:49 - Top-down / Button-up & Holistic / Partial  
14:21 - 존재하는 솔루션? 찾아 내야 하니? Existing / Emerging  
15:32 - 무엇을 향해? Oriented / Disoriented  
16:49 - 무엇을 중심으로? Centralized / Decentralized  
17:48 - 흐름은 어떤 한가? Procedural / Iterative  
18:20 - 최고? 혹은 최적? Ultimate(Best) / Optimal

19:47 - 이행/구현의 단계에서는 / Implementation  
20:09 - 무한에서 유한으로 - Infinite to Finite  
21:13 - 암묵적에서 명시적으로 - Implicit to Explicit / Ambiguous to Certain  
22:54 - 어떻게 나눌 것인가 - from Entangled to Separated  
24:17 - 현상에서 모델로 - Phenomenological(Observation) to Predictable(Model & System)

25:26 - 이행시 필요한 개념 / Implementation  
27:30 - 클래스의 정정 그리고 추상화 - Class / Abstraction  
28:51 - 요약하면

## DATA & PROCESS

# COMPUTATIONAL THINKING [link](#)

### THE QUESTION / IMAGINATION / HYPOTHESIS

*Understanding Problem, Concern & Issue  
Declaring Inputs & Outputs  
Writing Instructions*

### THE MANIFESTO & POLICY

*Deterministic or Stochastic  
Converge or Diverge — Design Space, Optimization, Pareto efficiency  
Top-down & Bottom-up  
Holistic or Partial  
Existing or Emerging (Revealing)  
Oriented or Disoriented  
Centralized or Decentralized  
Procedural or Iterative  
Ultimate(Best) or Optimal*

### SPATIAL DATA MANIPULATION

*Dumb or Smart — Component Oriented Programming, React, Unity3d  
Reciprocal (Mutual & Dependent) or Isolation (Independent)  
Public or Protected or Private  
Abstract or Concrete — Implementation and Inherent  
Connected or Disconnected  
Static or Dynamic (Instance)*

### THE METHODOLOGY & APPROACH

*from Whole to Parts & from Part to Whole  
from Simple to Complex & from Complex to Simple  
from Generic to Specific & from Specific to Generic*

### THE IMPLEMENTATION

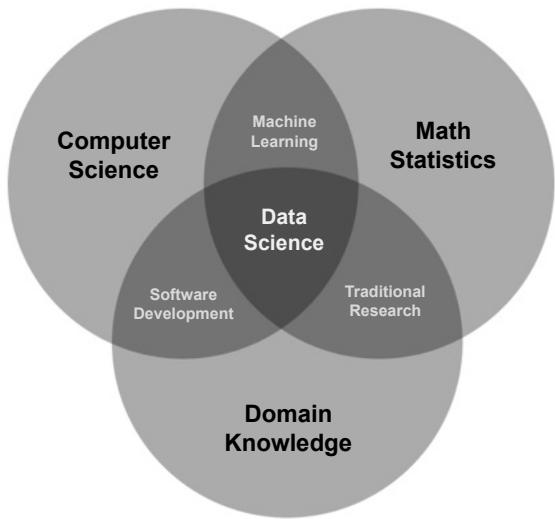
*from Infinite to Finite — FEM, Structure Analysis  
from Implicit to Explicit  
from Ambiguous to Certain  
from Entangled to Separated — Pipeline  
from Inactive to Interactive — Complex system  
from Phenomenological(Observation) to Predictable(Model & System)  
from Intuition(Imagination, Hypothesis) to Implementation*

### THE TOOL & THE PRINCIPAL

*Analytic-Oriented & Object-Oriented & Functional & Procedural & Component...  
Relational Hierarchy  
Properties and Behaviors  
Pure & Impure  
Condition & Loop  
Coordinate system, distortion, projection remap interpolation ...*

1. Differentiating Issues, Problems, and Tasks
2. Developing Spatial Data Structures
3. Deploying Algorithms

## DATA SCIENCE



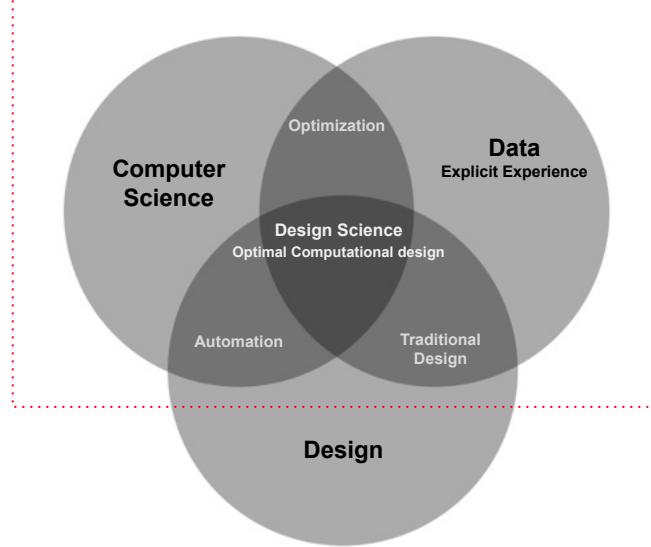
Computational XXX

Data Engineering

Data Science

...

## DESIGN SCIENCE



Computational Design

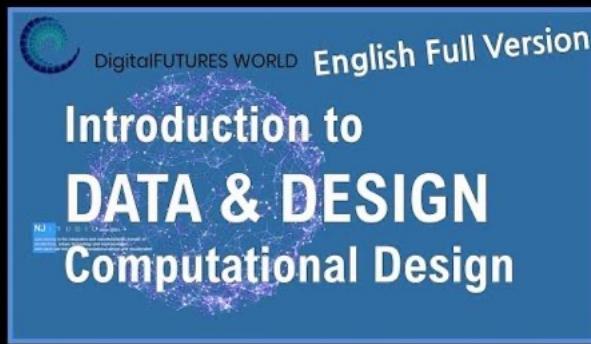
Design Engineering

Design Science

...

Today's topic

Workshop: Introduction to Computational Design: Data, Geometry, and Visualization Using Digital Media - [link](#)



00:24 - overview : data, methodology, and system  
06:43 - urban data / network  
08:46 - urban data / machine learning  
11:00 - geometry data / deep learning  
13:00 - optimization / parametric design  
15:58 - structure data / optimization  
18:41 - geometry data / dynamics  
20:24 - landscape data / environmental data  
22:28 - image data processing  
25:13 - fabrication data / digital mockup  
26:07 - material data / computation  
28:20 - interaction / robotics  
31:56 - particle simulation / data  
-----  
33:16 - other interests  
34:53 - lecture and workshop series  
35:24 - domains and technologies  
36:37 - keywords  
37:02 - thank you

ENG: <https://nj-namji.medium.com/data-design-c21457dc8dc>

KOR: <https://brunch.co.kr/@njnamji/88>

Code for design

**Codification of design process (decision makings)**

**디자인 프로세스의 코드화**

## **DESIGN & DATA** [link](#)

selected researches and projects

# URBAN ANALYSIS & AI, ML

<https://najmilee.github.io/njs-lab-public/project/2016-mobility-energy-consumption-mit-media-lab/>



## Addon for Grasshopper

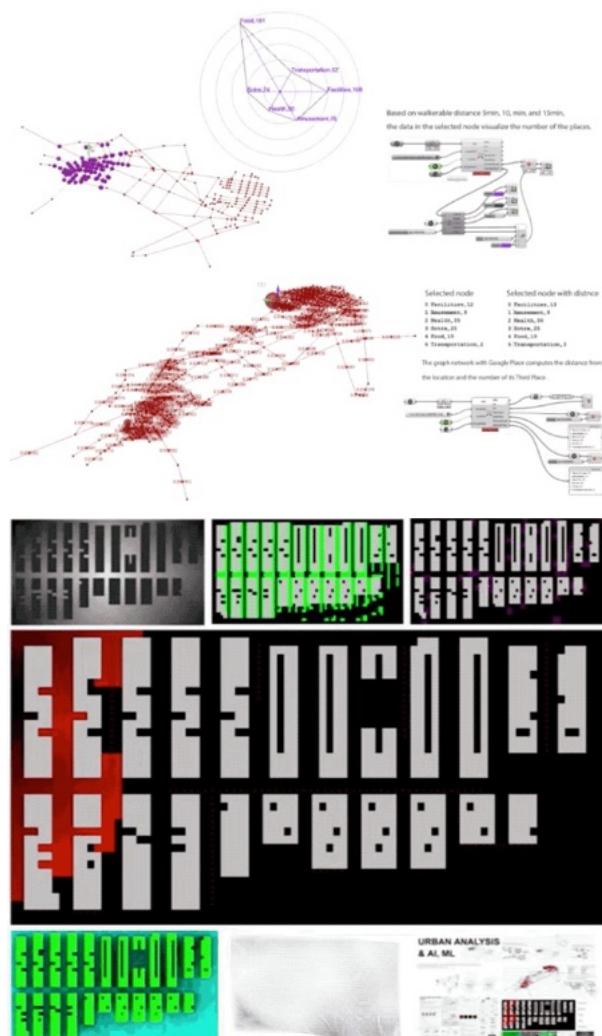
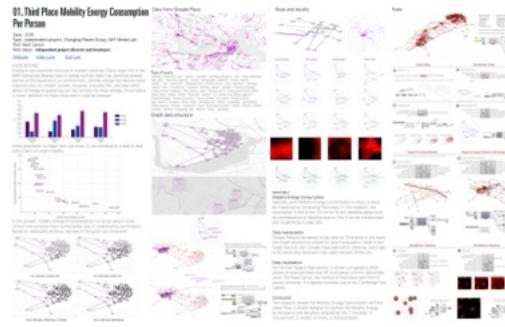
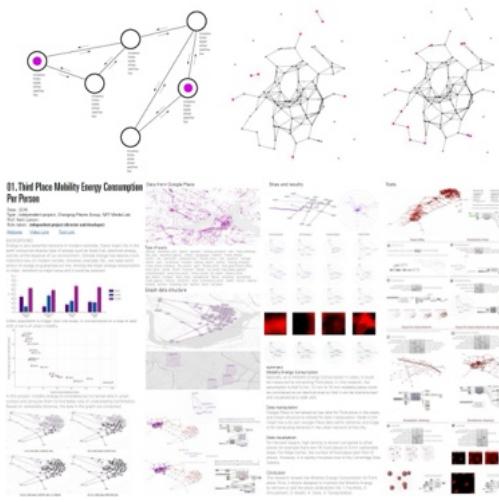
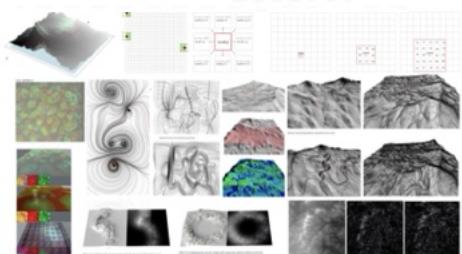
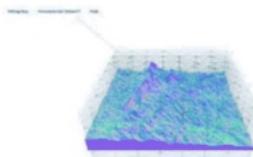
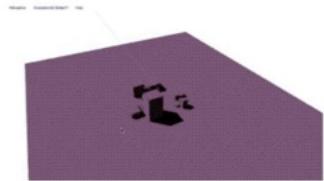
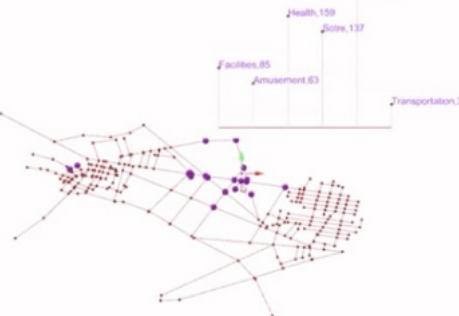
<https://www.food4>

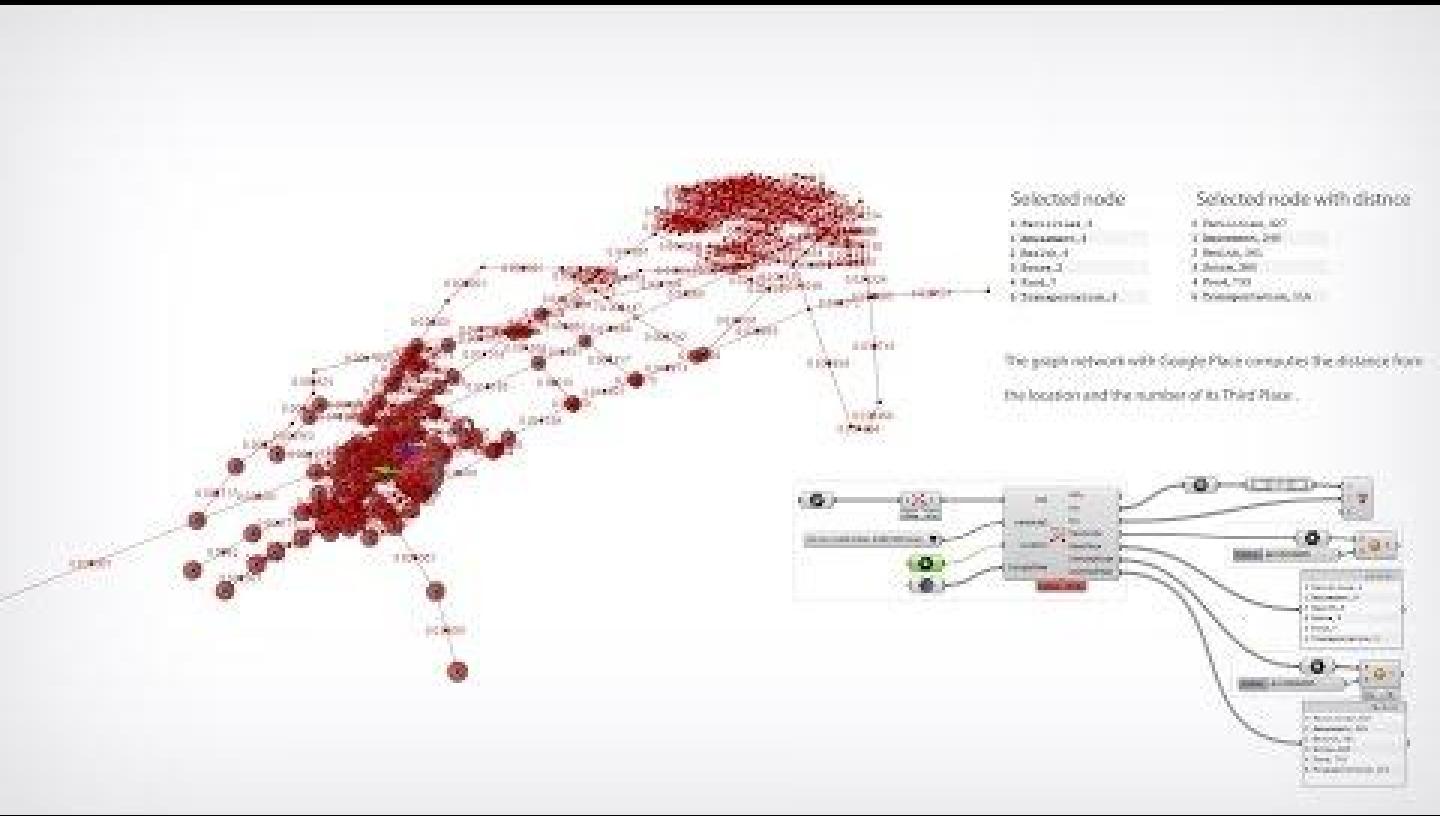
ANSWER

Paper: <https://www>

Paper: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8333333/>

U.S. GOVERNMENT PRINTING OFFICE: 1910. 100-197898. 535-2400-0





<https://namjulee.github.io/ns-lab-public/work?id=2016-mobility-energy-consumption-mit-media-lab>

Third Place Prediction model, Boston, LA, Redlands

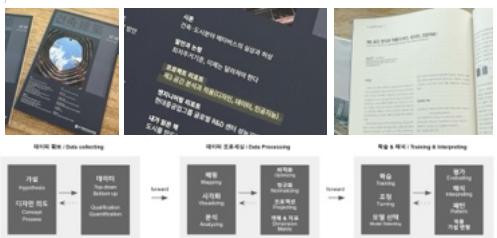
Data process, Model A, Model B, Implementation

Medium(Eng): <https://lnkd.in/gEzKJxYu>

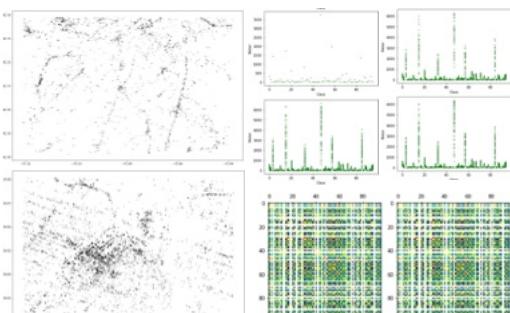
Brunch(Kor): <https://brunch.co.kr/@njinamju/148>

Source code: <https://lnkd.in/qdf6d8j7>

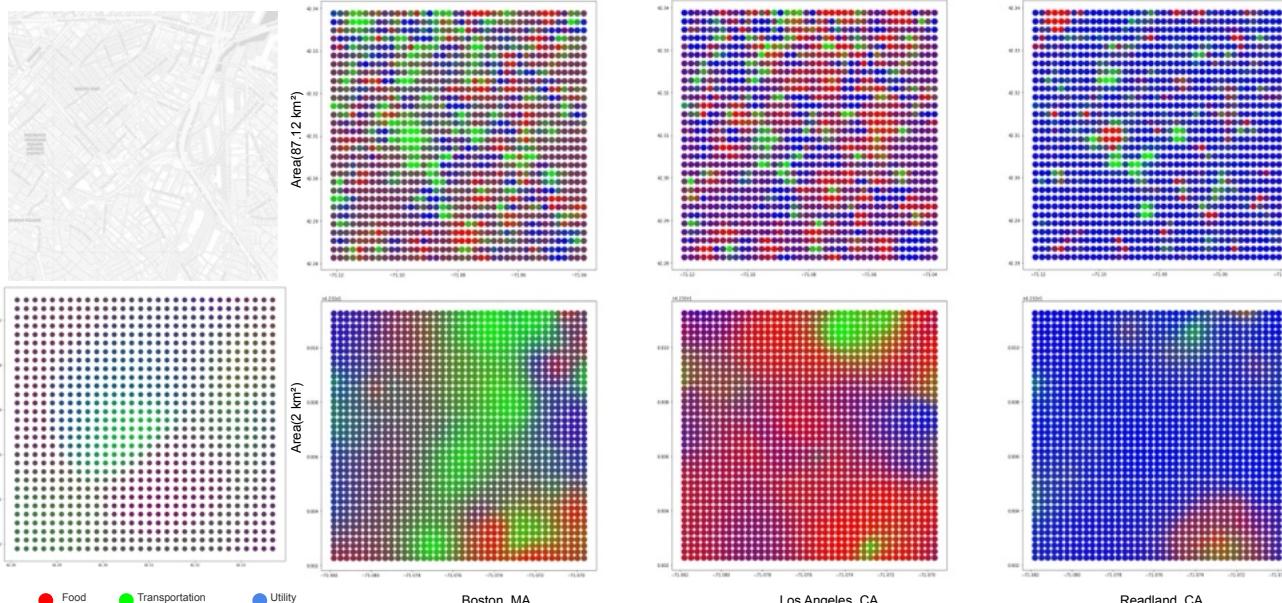
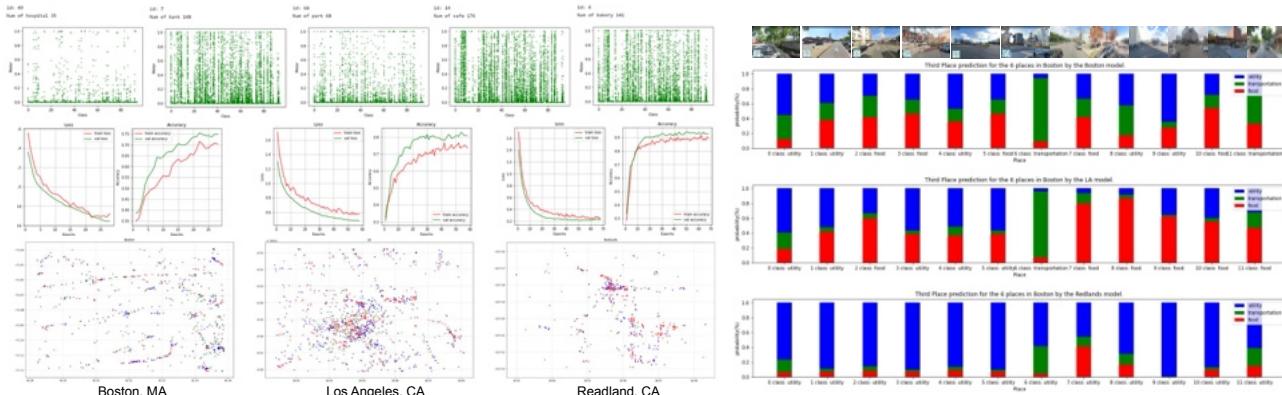
Lecture: <https://namiulee.github.io/Data-Design-AI-for-Urban-Data-and-Viz-Harvard-GSD-public/>



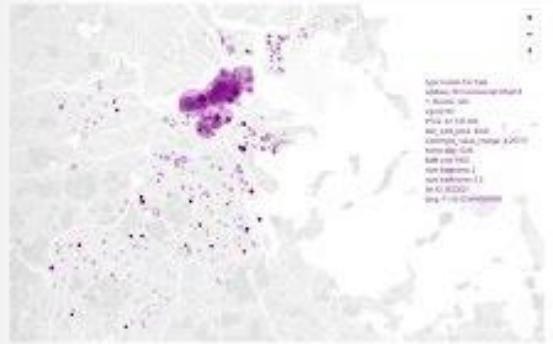
95 Class



### Third Place prediction results in Boston

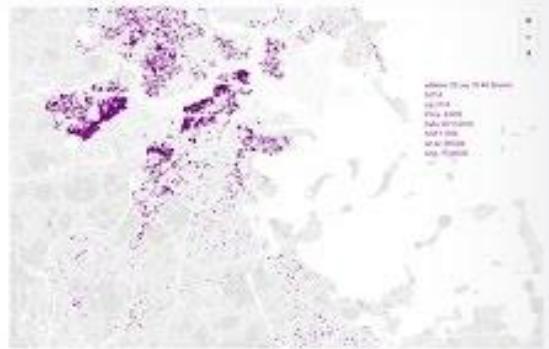






Housing Price data from Zillow

number of data used: 938 houses



Rent Price data from Trulia

number of data used: 13049 rents

## "Politics of Space and its Shadows" in the Seoul Biennale International Studios (SBIS):

Date : 2017

Type : architectural urban research exhibition

Role taken : Research and Visualization

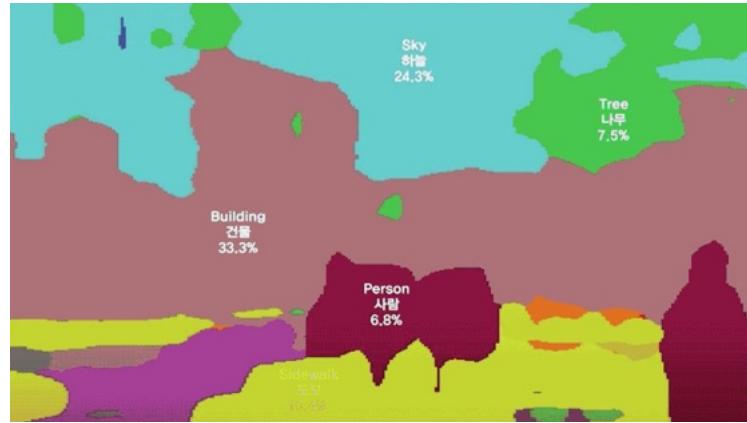
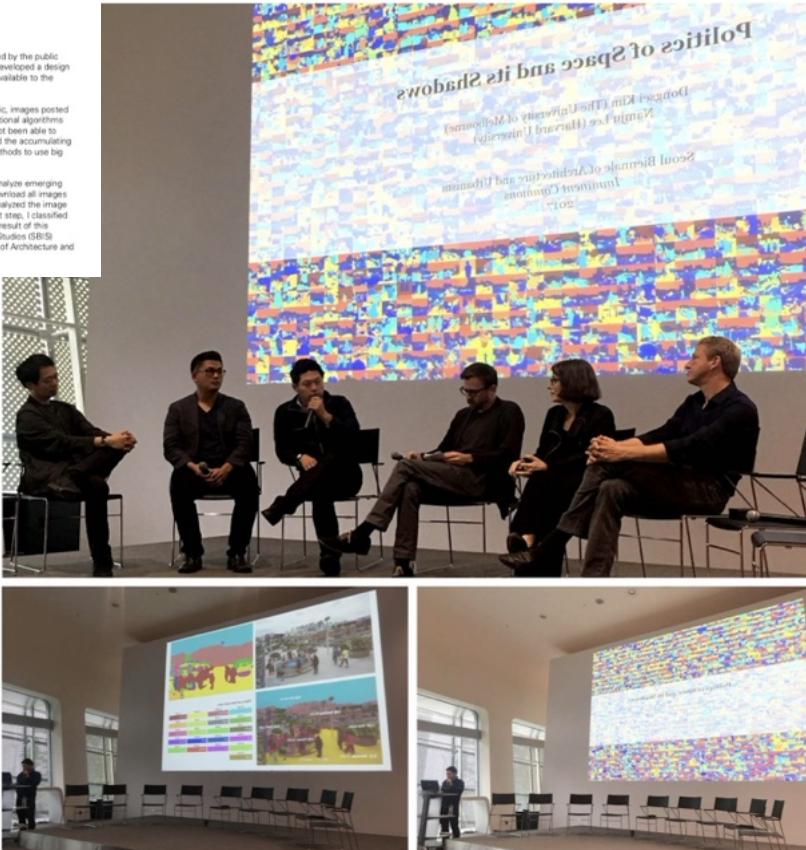
Link:

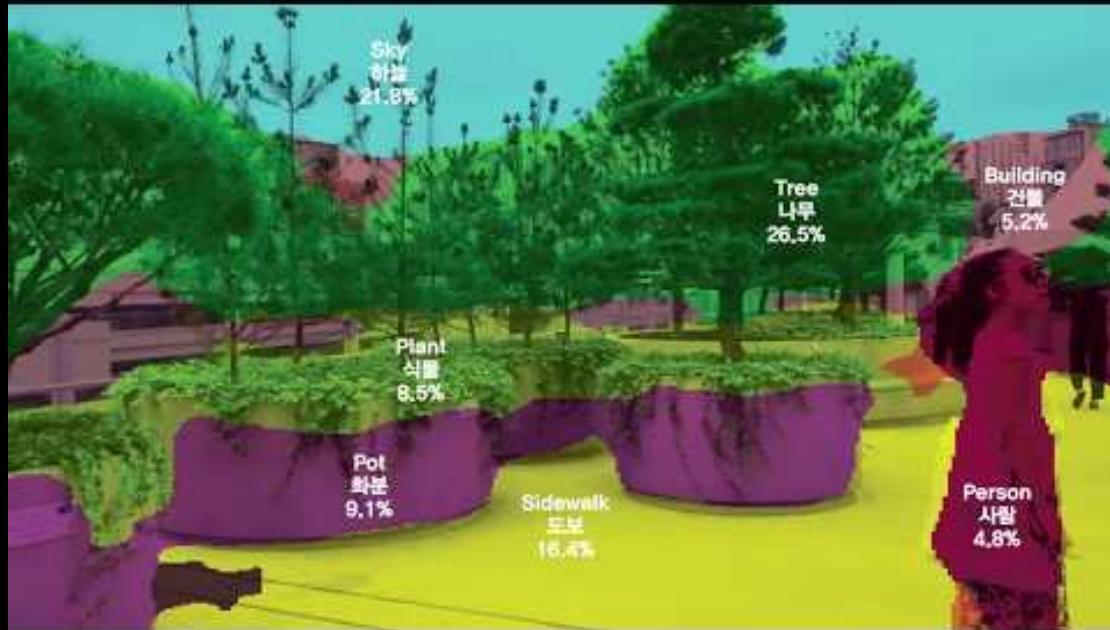
Overview of Project

This project examines how the changing urban environment is perceived by the public and how they are represented through new emerging technologies. I developed a design pipeline for the project that enabled analyzing and visualizing big-data available to the public.

There are an enormous amount of big data being produced by the public, images posted on Instagram is such example. In parallel, there are emerging computational algorithms that process such big-data. However, the urban design discipline has not been able to meaningfully bridge the gap between these emerging technologies and the accumulating big-data. This project attempts to bridge this gap by examining new methods to use big data to better understand public spaces.

The technical workflow is as follows: 1) parse data 2) process data 3) analyze emerging result from the raw data. In the first step, I developed a program to download all images that were posted on Instagram using the Instagram API. I then analyzed each image data and converted them into numerical data for processing. As the last step, I classified the results using important keywords associated with the images. The result of this research was invited and exhibited at the Seoul Biennale International Studios (SBIS) exhibition curated by John Hong (SNU) at the inaugural Seoul Biennale of Architecture and Urbanism directed by Hyungmin Park and Alejandro Zárate-Polo.





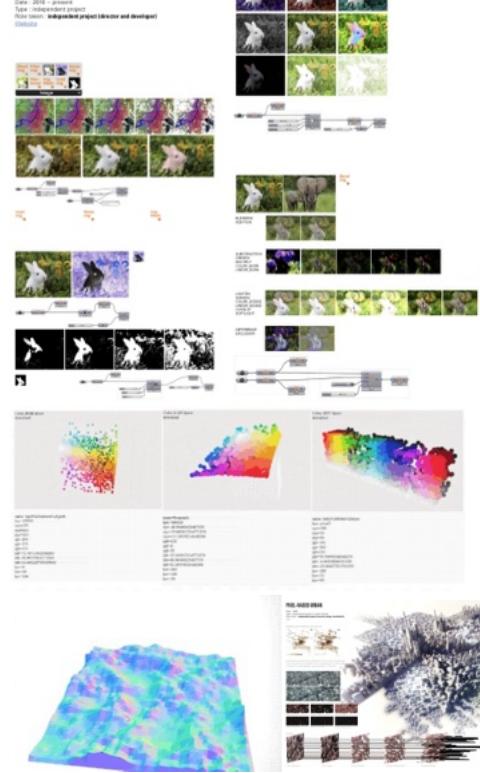
Link: <https://namjulee.github.io/ns-lab-public/work?id=2017-politics-of-space-shadows>

# IMAGE PROCESSING

remote sensing / color processing

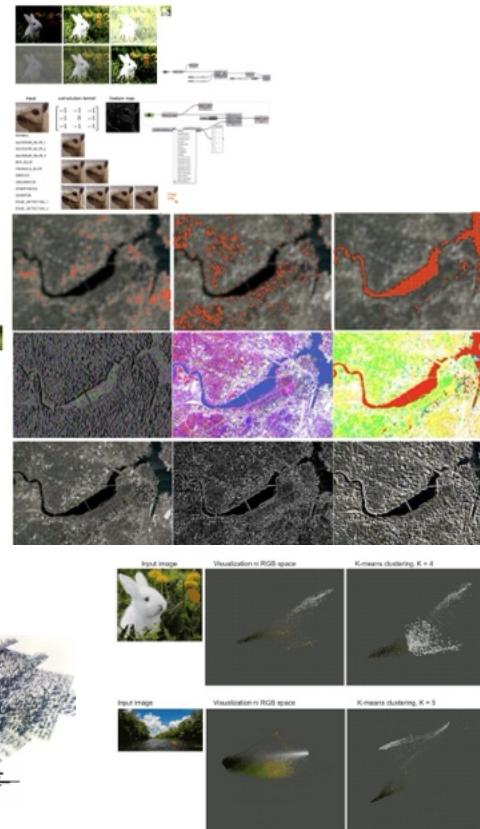
<https://namjulee.github.io/njs-lab-public/work?id=2018-nju-dev>

NUMERICAL IMAGE UTILITY  
AN ADD ON FOR GRASSHOPPER IMAGE PROCESSING



Addon for Grasshopper

<https://www.food4rhino.com/app/numerical-image-utility>



# AERIAL SEMANTIC SEGMENTATION

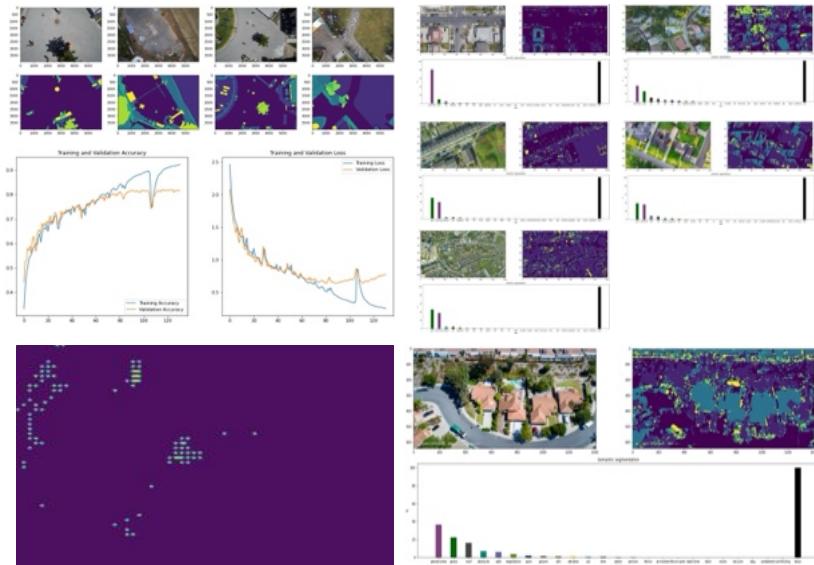
Machine Learning & Implementation

Link: <https://computationaldesign.tistory.com/29>

Reference: <https://www.kaggle.com/datasets/bulentsiyah/semantic-drone-dataset>

Classes

[unlabelled, paved-area, dirt, grass, gravel, water, rocks, pool, vegetation, roof, wall, window, door, fence, fence-pole, person, dog, car, bicycle, tree, bald-tree, ar-marker, obstacle, conflicting]



# SMTtracer

## Sketch to Map Translator

### ESRI Storymaps Hackathon

Link: <https://computationaldesign.story.com/28>

#### LANGUAGE

Python  
TypeScript

#### LIBRARY

Tensorflow, 2.5.0  
CV2, numpy, PIL, ...  
HTML Canvas, NJSCoreLib

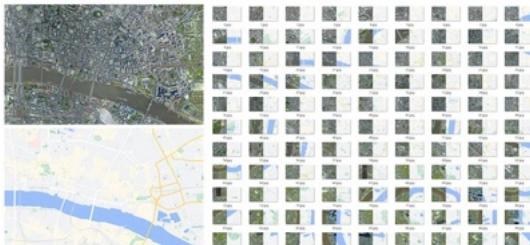
#### MODEL(NETWORK)

pix2pix: Image-to-image translation with a conditional GAN (a modified U-Net)

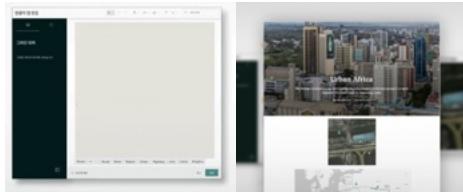
### Sketch-to-Map Translator



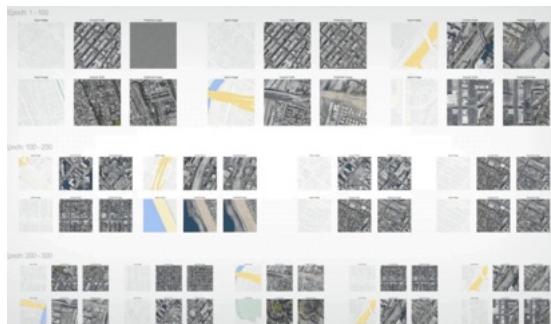
#### Data collection and preprocessing



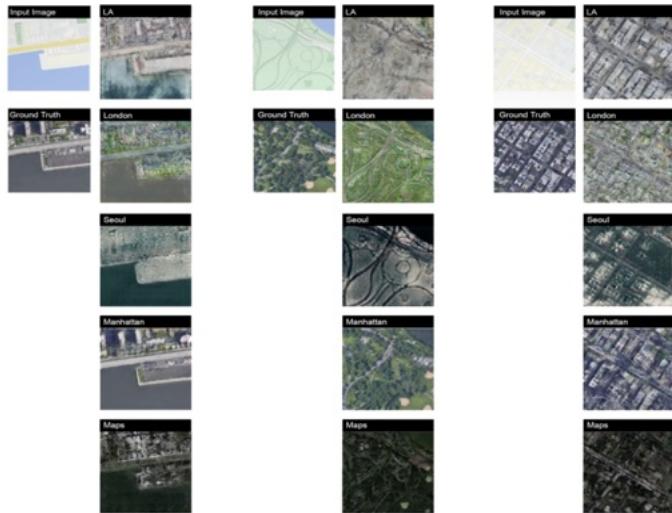
### Sketch App



### Training and Predictions

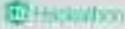


### Generated maps by different city looks(Seoul, London, Manhattan, LA ...)



### Generated maps by the machine





Generated maps by the machine



<https://namjulee.github.io/njs-lab-public/work?id=2021-smart-map-tracer>

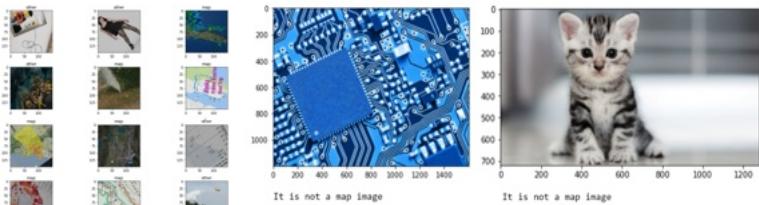
# Map Classifier

## Machine Learning & Implementation

Link: <https://computationaldesign.tistory.com/29>

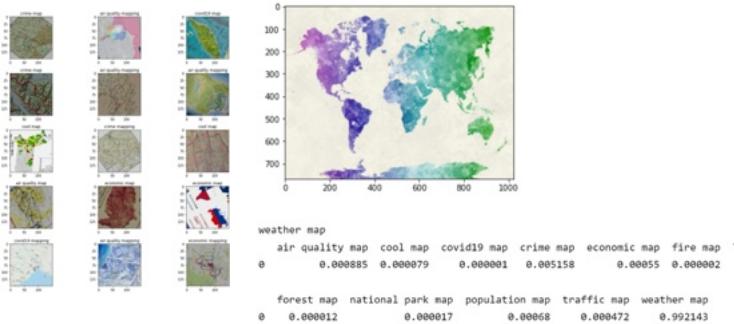
### Classes

2 : [map, other]



### Classes

22 : [air quality map, air quality mapping, cool map, cool mapping, covid19 map, covid19 mapping, crime map, crime mapping, economic map, economic mapping, fire map, fire mapping, forest map, forest mapping, national park map, national park mapping, population map, population mapping, traffic map, traffic mapping, weather map, weather mapping]

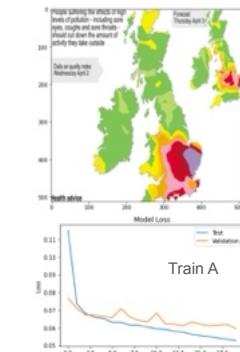


# Map Super Sampling

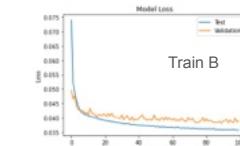
## Machine Learning & Implementation

Link: <https://computationaldesign.tistory.com/29>

Train data : 3,000 (maps)



Train A



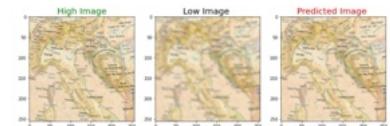
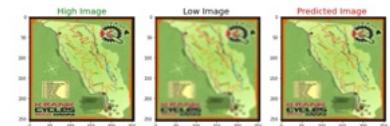
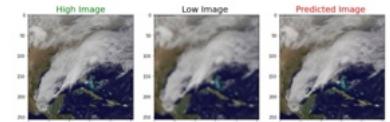
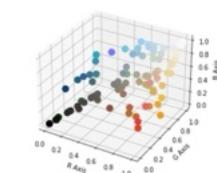
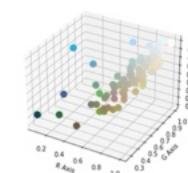
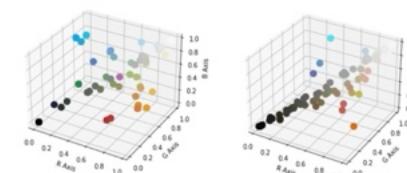
Train B

0 air quality map

7 crime mapping

15 national park mapping

17 population mapping

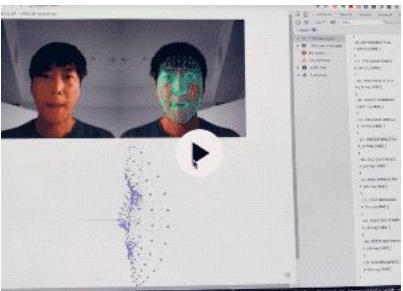


# THE COLOR AI

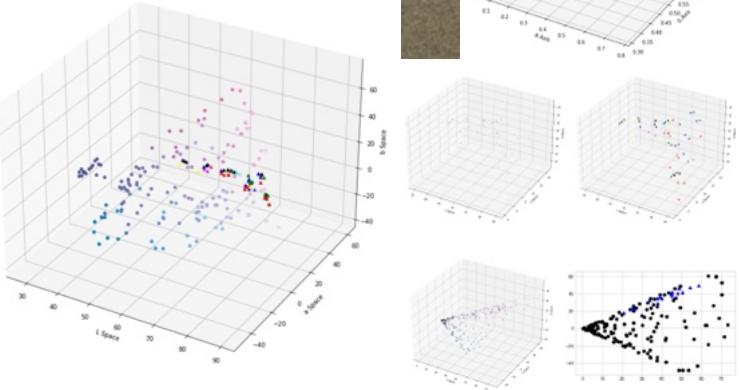
Machine Learning & Implementation

Link: <https://computationaldesign.tistory.com/29>

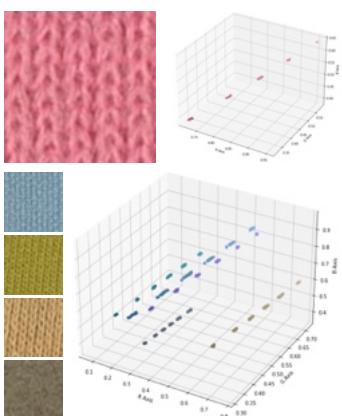
Personal Color & prediction and implementation



[Demo](#)



Texture detection

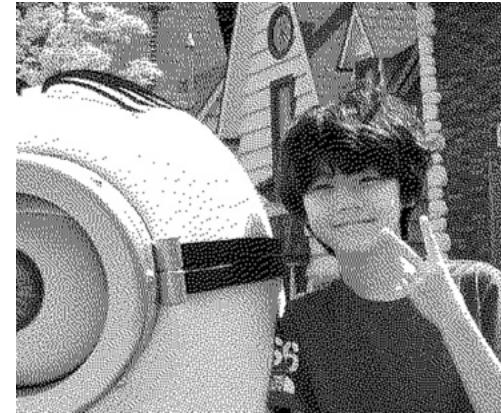


# REST API and Image Processing

Machine Learning & Implementation

Link: <https://computationaldesign.tistory.com/29>

[Demo](#)



[Demo](#)



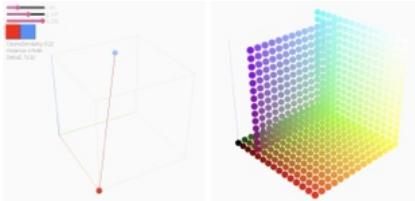
Color Correction : hue / contrast / saturation / invert / image filters



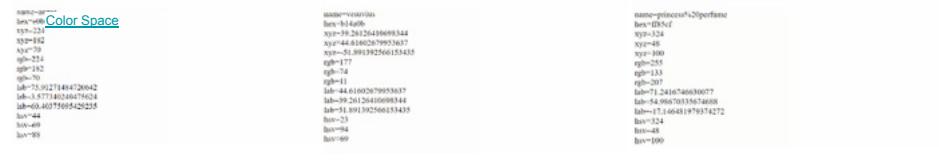
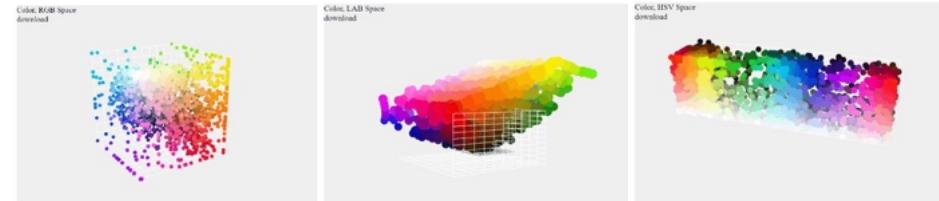
[Demo](#)

# COLOR DATA

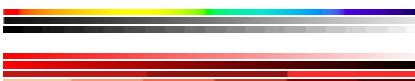
## colors spaces



[Color Difference](#)



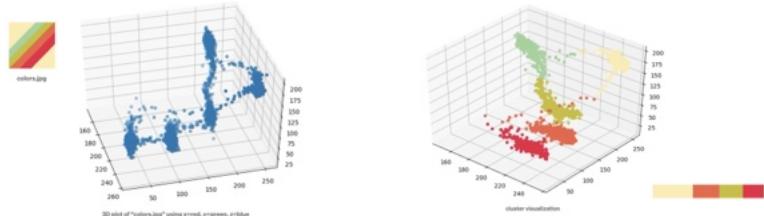
## color as scales



[Color Space](#)

<https://github.com/nmljlee/lab-public/lab/color/color%20space%20.html>

Dominant colors  
in an image using k-means clustering



Ref: <https://buzzrobot.com/dominant-colors-in-an-image-using-k-means-clustering-3c7af4622036>

# NNA, NUMERIC NETWORK ANALYSIS TOOLBOX

## Lecture:

<https://namjulee.github.io/nis-lab-public/work/?id=2020-discrete-urban-space-connectivity>

## Medium:

[https://ji-namji.medium.com/numeric-network-a  
nalysis-post-covid-19-urbanism-6-ft-rule-de2678  
86b028](https://ji-namji.medium.com/numeric-network-analysis-post-covid-19-urbanism-6-ft-rule-de267886b028)

## Addon For Grasshopper

[https://www.food4rhino.com/app/numeric-network  
analysis-nna](https://www.food4rhino.com/app/numeric-network-analysis-nna)

## Lecture, NYIT

[https://youtu.be/\\_9l7dp5q6A0](https://youtu.be/_9l7dp5q6A0)

## Accessibility Analysis

Reach, Gravity, Huff-model

## Centrality Analysis

Betweenness, Closeness, Straightness,  
Degree

### SITE ANALYSIS Betweenness

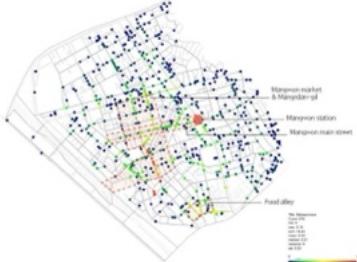
#### Definition of betweenness

$$\text{Betweenness}[k]^* = \sum_{i \neq j \in \text{set}(k) \cap \text{set}_1} \frac{N_d(i,j)[k]}{N_d(i,j)}$$

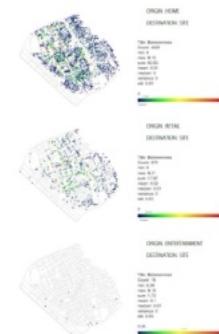
The Betweenness Index is the total number of shortest paths ( $N_d$ ) at the target location ( $i$ ) divided by the total number of shortest paths that exist between two nodes ( $i$ ) and ( $j$ ) of a given radius ( $R$ ).

The target node ( $i$ ) would have a high betweenness centrality if it appears in many shortest paths to the node that estimates realistic pedestrian flows in the network.

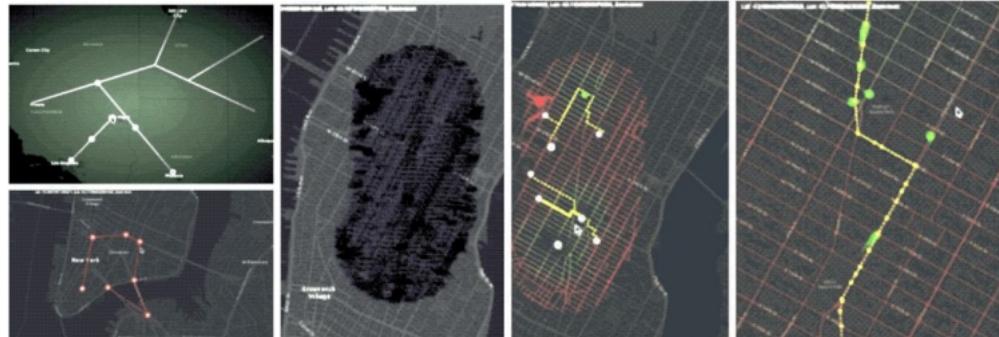
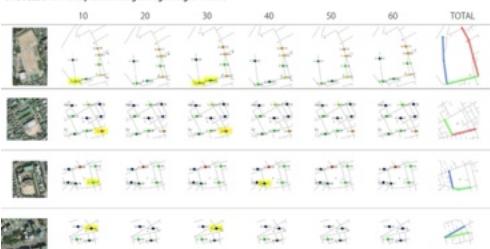
Title	: Betweenness
Origin	: retail
Destination	: entertainment
Count	: 878
Min	: 0
Max	: 0.19
Sum	: 19.24
Mean	: 0.02
Median	: 0.01
Variance	: 0
Std	: 0.03



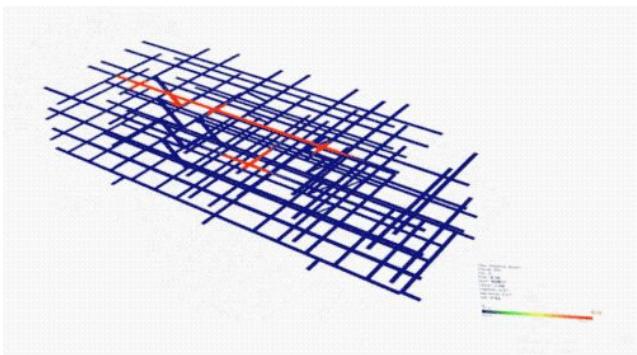
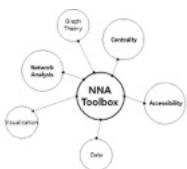
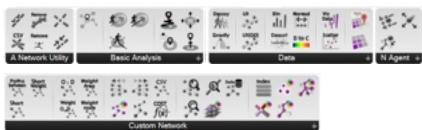
### SITE CONTEXT betweenness - site



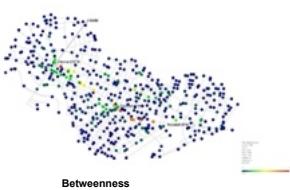
### SITE SELECTION comparison using the age weight of NNA



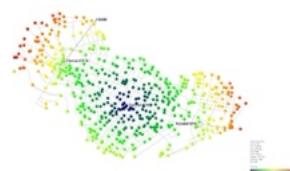
Graphic User Interface for the GH implementation



**Degree**  
(No. connectivity at each node)



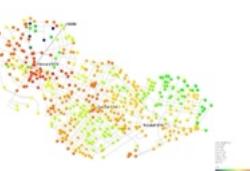
**Betweenness**  
(Home to MBTAs)



**Closeness**  
(Home to MBTAs)



In graph theory, **Centrality** estimates to determine the hierarchy of **nodes** or **edge** within a network. The centrality analysis uses for diverse urban scales for local and global. A local centrality defines the distance between nodes within a given radius and a global centrality calculates the distance between nodes in a whole system. The Centrality Index is useful to understand the operational analysis of network flow tendency in transportation geographies, such as airline networks, road networks, and canal networks. As well as it measures to understand a node (location) importance in space.



**Straightness**  
(Home to MBTAs)



**Huff**  
(Probability to visit locations)



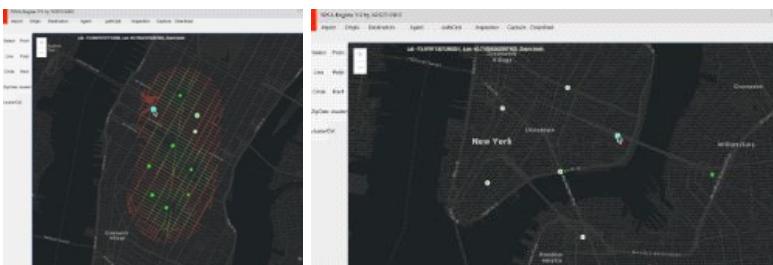
**Reach**  
(No. Accessible Homes from MBTAs in 1000M)



**Gravity**  
(Discounted No.accessible Homes from MBTAs in 1000M)



**Accessibility analysis** has been researched in the field of physical planning and spatial modeling for over 50 years. The concept of accessibility explains both **activity patterns in space** and the **connections between activities** linked to Newton's law of gravity. Hansen's "How Accessibility Shapes Land Use" (1959) was the first defined paper about accessibility as a potential of using urban planning.

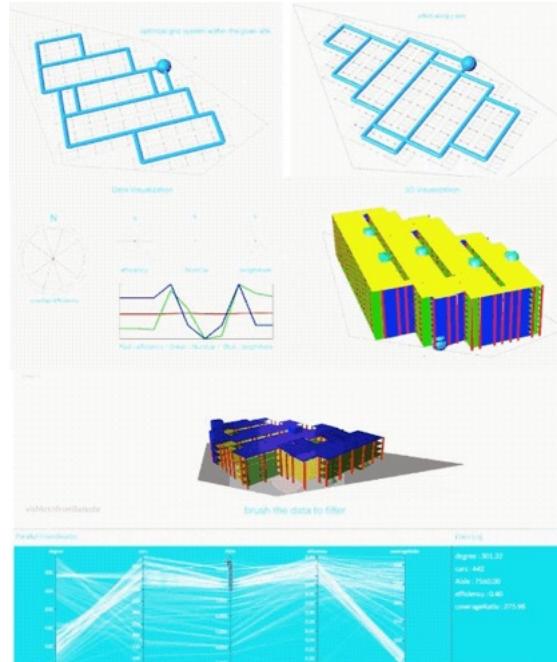


# PARAMETRIC & OPTIMIZATION 2016

<https://namiulee.github.io/njs-lab-public/work?id=2016-parkeator-flux-factory>

FLUX  
SINGAPORE  
FACTORY

Problem & Aim  
Optimizes design of parking building.  
Input: parking  
output: parameters



## PARKERATOR in Flux Factory [Data Driven Design]

Data - 2016  
Parkeator Application Engineer Intern | Computational Designer in Flux Factory  
Role Taken : research, design modeling, visualization

Web Link | Parkerator 1 Link | Parkerator 2 Link

**Optimized design output:**  
At a first project of Flux, I developed a multi-story car park (MSCP) configurator for SJ in Singapore. Among the many challenges, I had to learn how to use Python API to interact with the Flux Engine and Graphpaper to generate parking buildings. I was one of the most involved projects for the implementation of Flux. I have been involved in the design of the car park, the optimization of the car park, and the automated process of generating the car park in the construction phase. (1) It should be fully automated process before decision making phase.  
(2) It should be able to generate the car park in real time.  
(3) It should provide the maximum usage capacity provider for an arbitrary site.

Singapore being one of the densely city in the world, the whole objective of the project was to leverage computer intelligence to provide the most optimized parking design for space allocation.

**Parkerator Phase 1**  
At a first project of Flux, I developed a multi-story car park (MSCP) configurator for SJ in Singapore. Among the many challenges, I had to learn how to use Python API to interact with the Flux Engine and Graphpaper to generate parking buildings. I was one of the most involved projects for the implementation of Flux. I have been involved in the design of the car park, the optimization of the car park, and the automated process of generating the car park in the construction phase. (1) It should be fully automated process before decision making phase.  
(2) It should be able to generate the car park in real time.  
(3) It should provide the maximum usage capacity provider for an arbitrary site.

Singapore being one of the densely city in the world, the whole objective of the project was to leverage computer intelligence to provide the most optimized parking design for space allocation.

**Parkerator Phase 2**  
The places we have build to advance 3D capabilities:  
(1) New automated rendering module which can automatically generate the car park based on the input data.  
(2) Input data can be taken as a files, and provide users with the data for their intuitive design.

Now our car park is designed and improved the algorithm from Parkerator Phase 1



**Grid Optimizer**  
At a first step of the project, we created a Grid Optimizer that shapes a grid domain in which car can be parked in arbitrary locations. This domain is generated from a algorithm. It creates a data set, which is a list of coordinates where each coordinate is a tuple of x,y,z. It also provides user with an optimal mode to find the best location for a car to park. In addition, it also provides user with a manual mode to change the location of every car in the grid. The 'Find' option automatically returns the optimal parameter in the data that user provide.

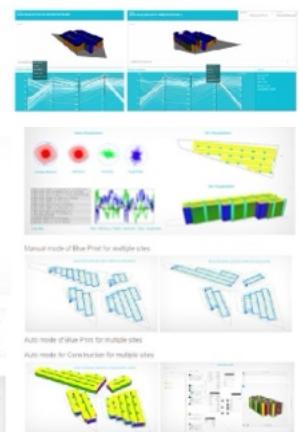
**Data Optimizer**  
At a first step of the project, we created a Grid Optimizer that shapes a grid domain in which car can be parked in arbitrary locations. This domain is generated from a algorithm. It creates a data set, which is a list of coordinates where each coordinate is a tuple of x,y,z. It also provides user with an optimal mode to find the best location for a car to park. In addition, it also provides user with a manual mode to change the location of every car in the grid. The 'Find' option automatically returns the optimal parameter in the data that user provide.

**Blue Print & Construct**  
At a first step of the project, we created a Grid Optimizer that shapes a grid domain in which car can be parked in arbitrary locations. This domain is generated from a algorithm. It creates a data set, which is a list of coordinates where each coordinate is a tuple of x,y,z. It also provides user with an optimal mode to find the best location for a car to park. In addition, it also provides user with a manual mode to change the location of every car in the grid. The 'Find' option automatically returns the optimal parameter in the data that user provide.

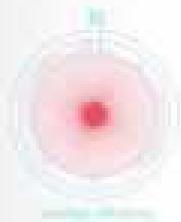
**Optimizer**  
Change the boundary condition based on an arbitrary site boundary conditions

- Manual mode for those who want to explore the design space  
- Optimal mode for those who want to find the optimal option in a mouse click

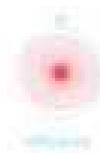
**Parameter**  
- Site boundary condition (boundary)  
- A writing point (point or vector)  
- Auto mode / Manual Mode / with degree (float / number)



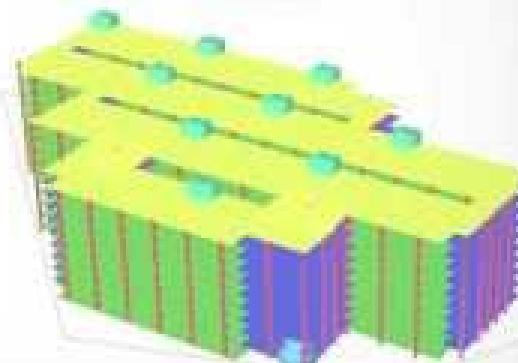
FLUX



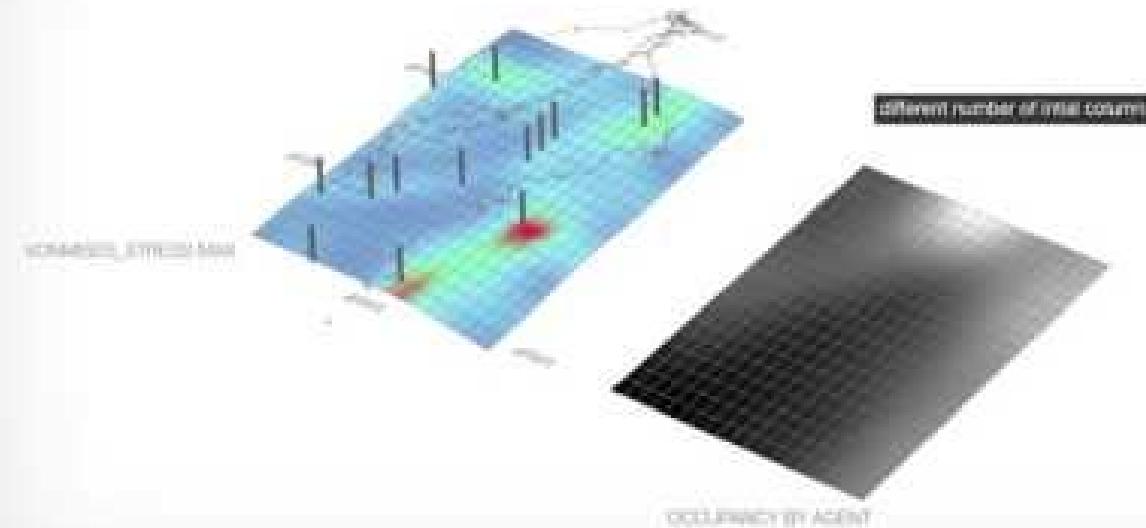
Cell division



Cell division







<https://namjulee.github.io/njs-lab-public/work?d=2015-column-distribution>

# DESIGN SYSTEM & AI, ML VOXEL REPRESENTATION

Long:<https://namjulee.github.io/njs-lab-public/project/2017-thesis-voxel-harvard-gsd/public/>

Short:<https://namjulee.github.io/njs-lab-public/work?id=2017-thesis-voxel-harvard-gsd>

## REMIXING & RESAMPLING THREE DIMENSIONAL OBJECTS Use of Volumetric Representations and Machine Learning in design

Date : 2016 - 2017

Type : thesis project at Harvard GSD

Role taken : independent project

Website

Digital Design Prize, class of 2017, Harvard GSD



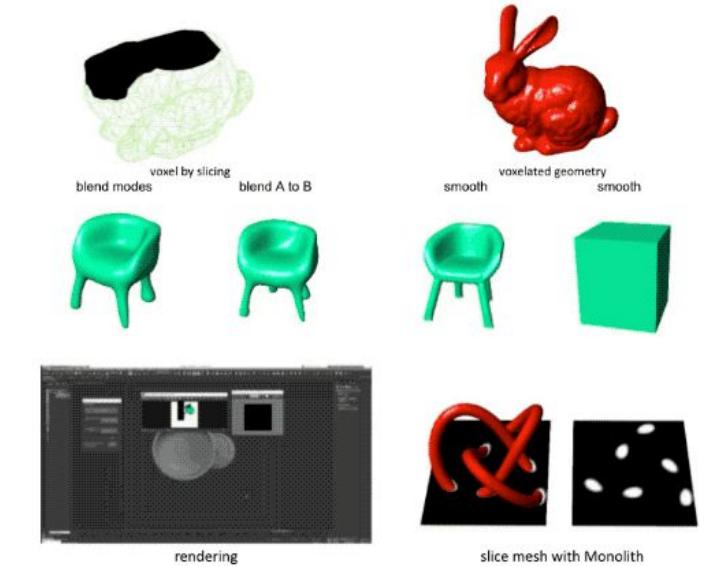
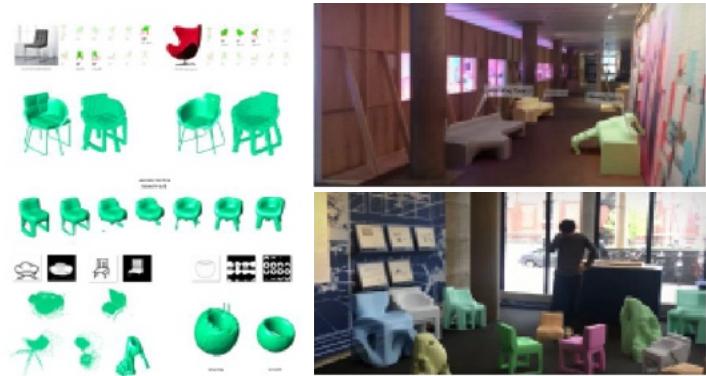
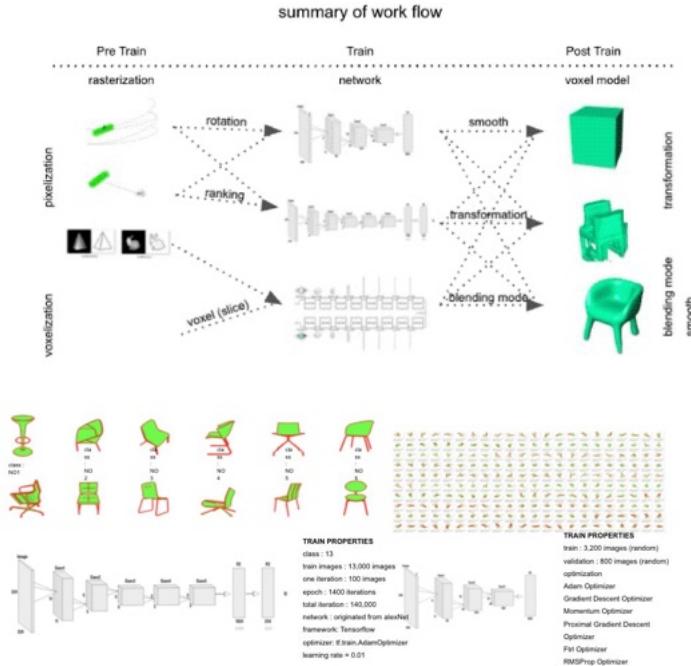
### ABSTRACT

This thesis aims to explore the opportunities of remixing and resampling three-dimensional geometry by using volumetric representations and machine learning. A voxel is a volumetric element representing a fragment of space. There are various types of implementations of voxel representations in different fields such as game design, simulations, architecture, fabrication, medical or computational design.

The thesis consists of the following parts. First, it introduces what voxel modeling is, compared to traditional modeling techniques. It looks at the advantages and disadvantages of a voxel representation and its applications in digital design. Second, it presents the **VOXEL WORKS** modeling paradigm. It also describes characteristics of voxel space covering as pixelated and voxelized space, as a dense representation (implicit relations) compared to sparse representation (explicit relations), and its data manipulation in relation to voxel space.

Secondly, the thesis presents the first part of the thesis, which is the proposed system. It is possible to leverage the developments of the past few years in the field of image analysis and machine learning and extend them into the third dimension. Therefore, the second part of the thesis investigates the use of machine learning techniques with the opportunities for pixelated and voxelized representation of 3D geometry by analytical inference, numerical modification, and blending multiple volumetric geometries.

The thesis examines several prototypical implementations of proposed design systems or workflows, as a series of experiments based on the process from rasterization, (1) pixelated, (2) voxelated (3) depth, of 3D geometry with machine learning, (1) convolutional neural networks(CNN) and Generative Adversarial Networks(GAN), in order to show new types of geometries by voxel blending.

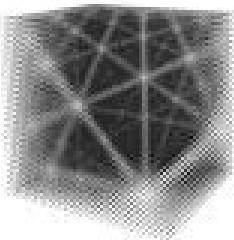




Harvard University  
Graduate School of Design

Design workflows integrating Machine Learning and voxel representations

**Remixing & Resampling Three Dimensional Objects  
Use of Volumetric Representations and Machine Learning in Design**



Adviser: Prof. Pervez Patel, Microbiology, Harvard (2013)

Advisor: Prof. Tomohiko Nagayama, MIT

N.J. Namju Lee

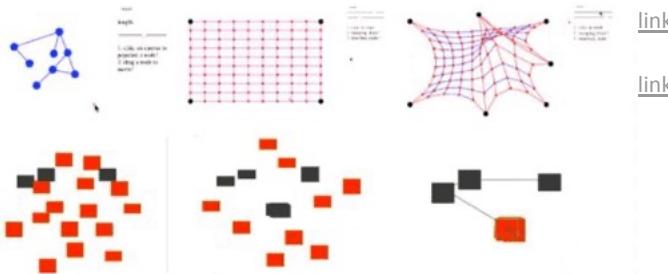
Thesis project, MDes

# Geometry and Position Optimization

based on graph and spring model physics

## Position Optimization

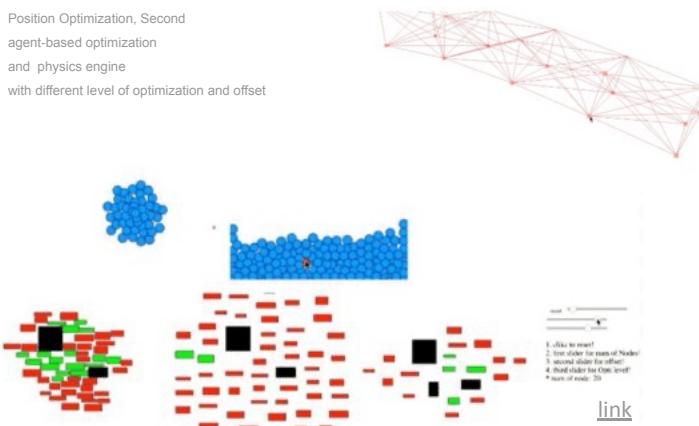
based on graph and spring model physics  
Experimentation for overlapping text boxes  
with constraints



## Position Optimization, Second

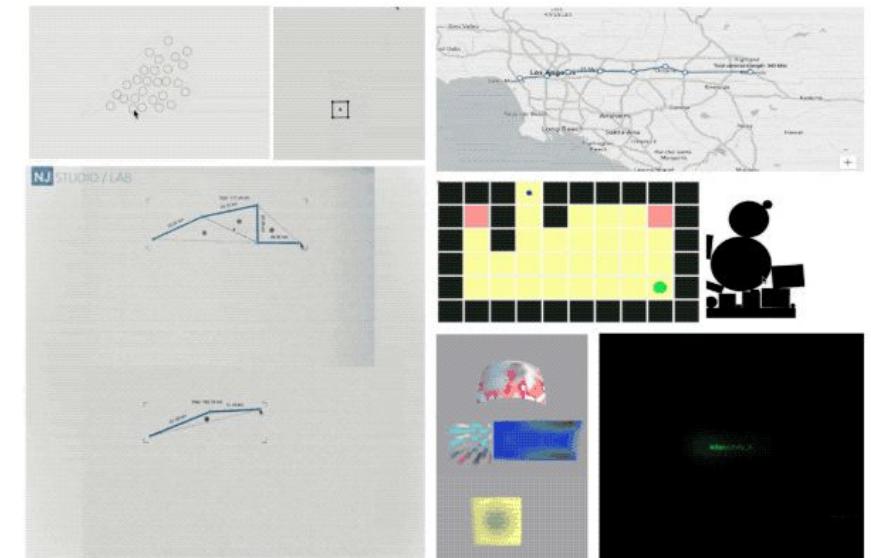
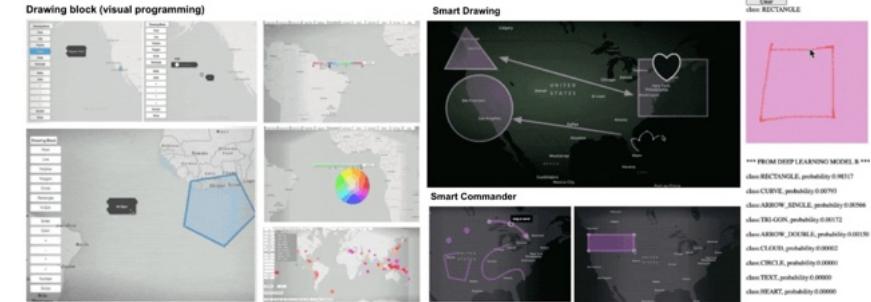
agent-based optimization  
and physics engine

with different level of optimization and offset

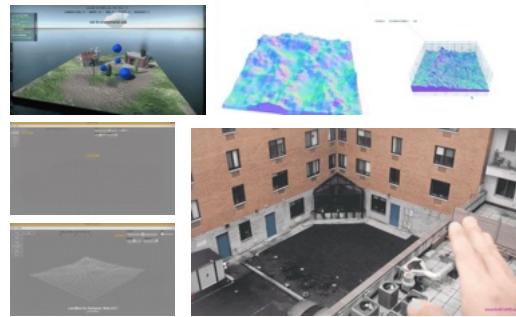


# Advanced Geometry manipulations

Dynamics, Spring, Voxel, Shader ...



# LANDSCAPE & ENVIRONMENT



<https://namjulee.github.io/njs-lab-public/work?id=2015-neu-development>

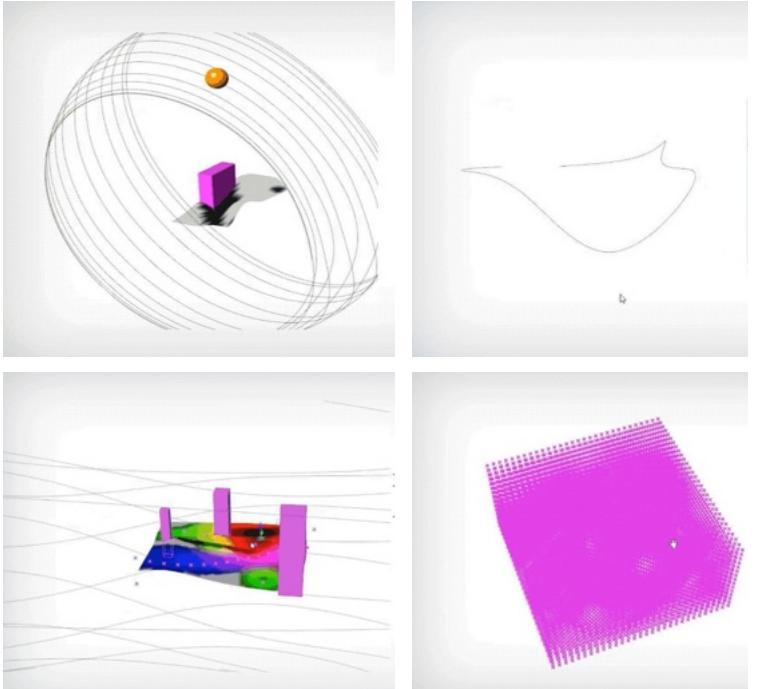
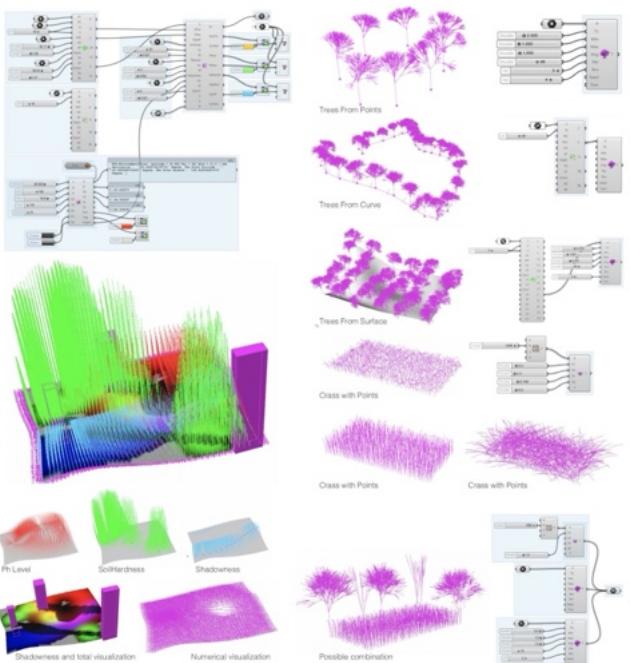
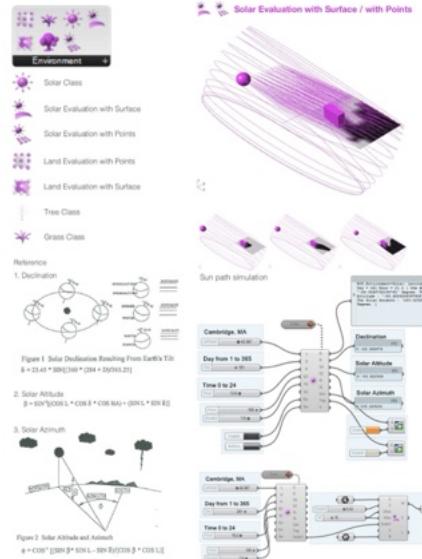
Addon for GH

<https://www.food4rhino.com/app/numerical-landscape-utility>

## NUMERICAL ENVIRONMENT UTILITY AN ADD ON FOR GRASSHOPPER FOR SIMULATION

Date : 2014 ~ present  
Type : independent project  
Role taken : **independent project (director and developer)**

Website





Development

# Numerical Environment Utility

data in pixel and voxel, Version 2015

-  3D viewer
-  3D visualization
-  3D reconstruction
-  3D reconstruction with PBR
-  3D rendering with PBR
-  3D rendering with PBR
-  3D reconstruction with texture
-  3D reconstruction with texture
-  3D reconstruction with texture
-  3D reconstruction with texture
-  3D reconstruction with texture

[www.njsstudio.co.kr](http://www.njsstudio.co.kr)

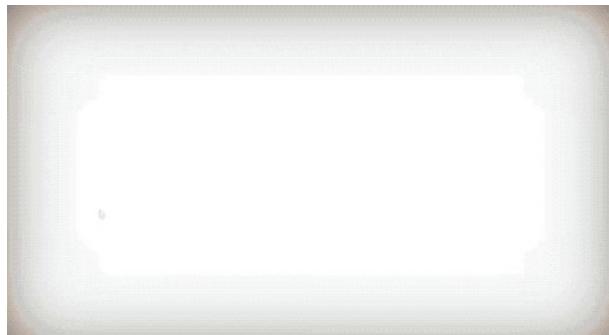
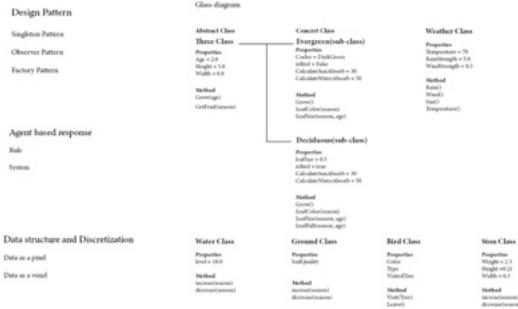
<https://namjulee.github.io/njs-lab-public/work?id=2015-neu-development>



<https://namjulee.github.io/njs-lab-public/work?id=2015-landbox-for-ar-development>

# DESIGN SYSTEM & COMPLEX SYSTEM

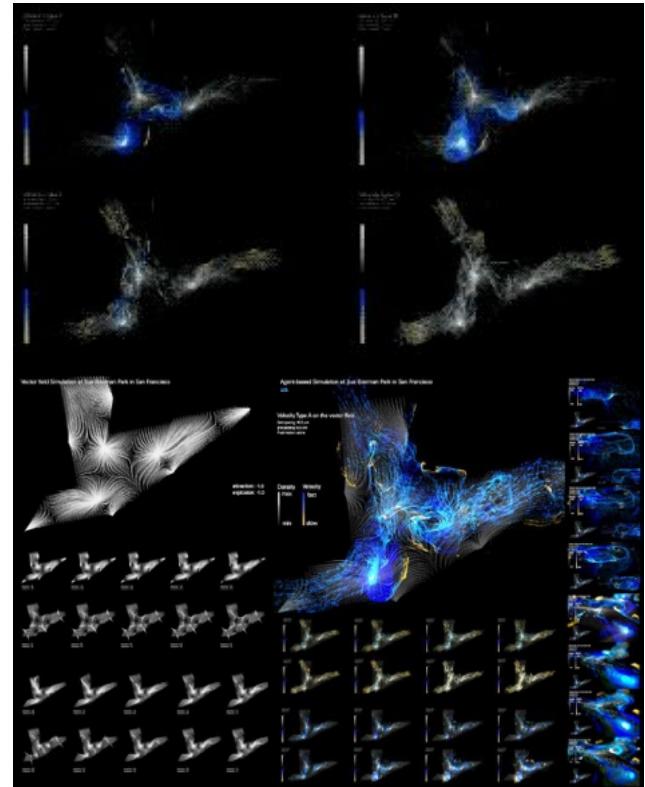
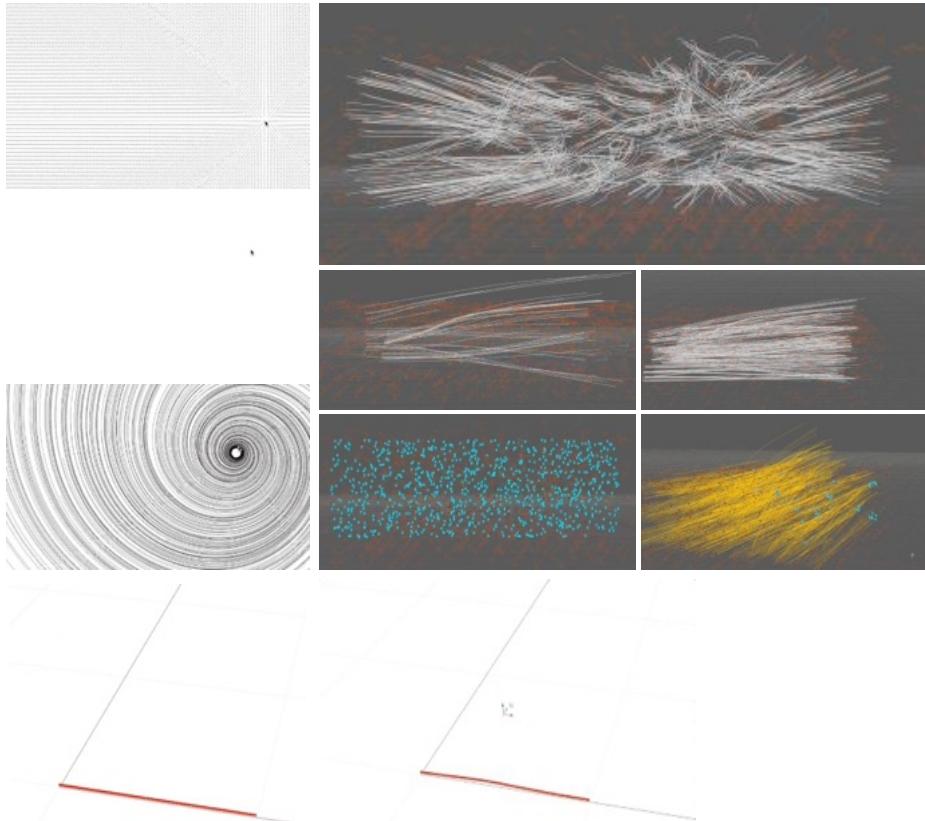
[http://www.njstudio.co.kr/main/project/2016\\_SmallEnvironments/2016\\_SmallEnvironments.html](http://www.njstudio.co.kr/main/project/2016_SmallEnvironments/2016_SmallEnvironments.html)





# Field & Particle

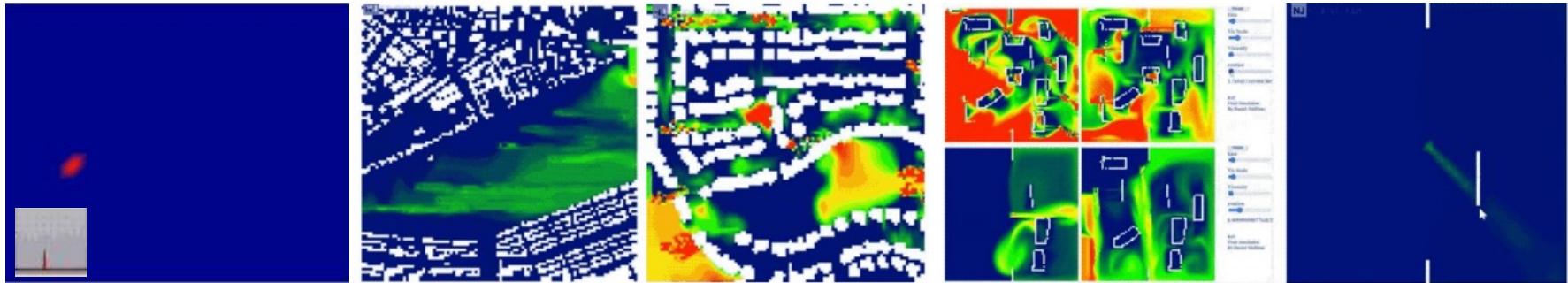
DYNAMICS



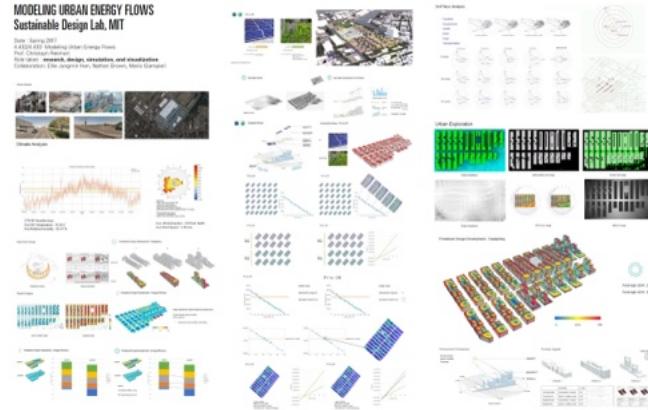
# Field & Particle

DYNAMICS

Fluid dynamics simulation- [Lab link](#)



MODELING URBAN ENERGY FLOWS  
Sustainable Design Lab, MIT  
Sustainable Design Lab  
a RIBA RPD Awarding Urban Energy Fellowships  
New urban research, design, simulation, and visualization  
Technologies for the built environment and climate change



COMPUTATIONAL FLUID DYNAMICS  
Experiment, Harvard GSD



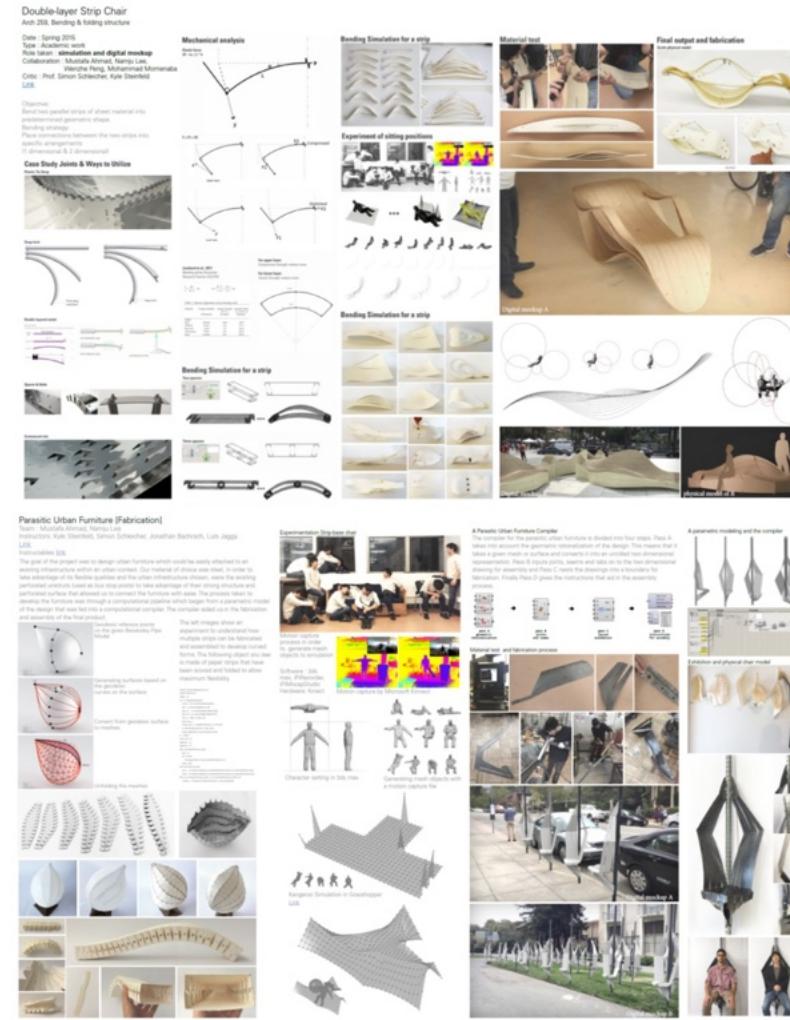
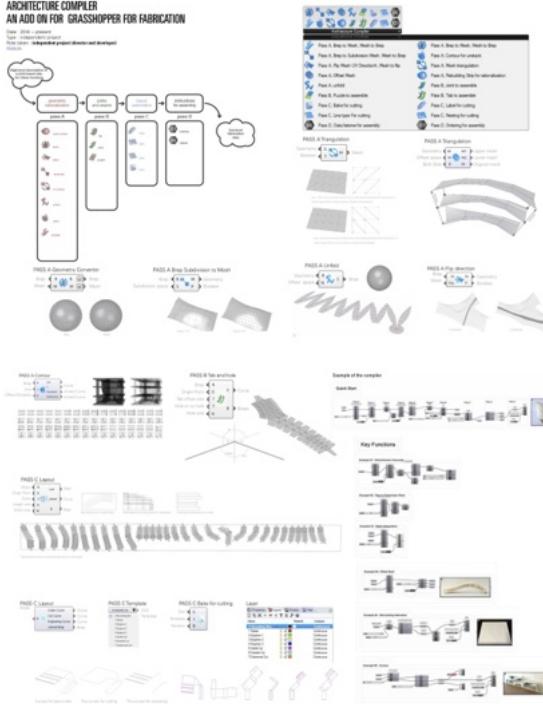
# FABRICATION & DIGITAL MOCKUP

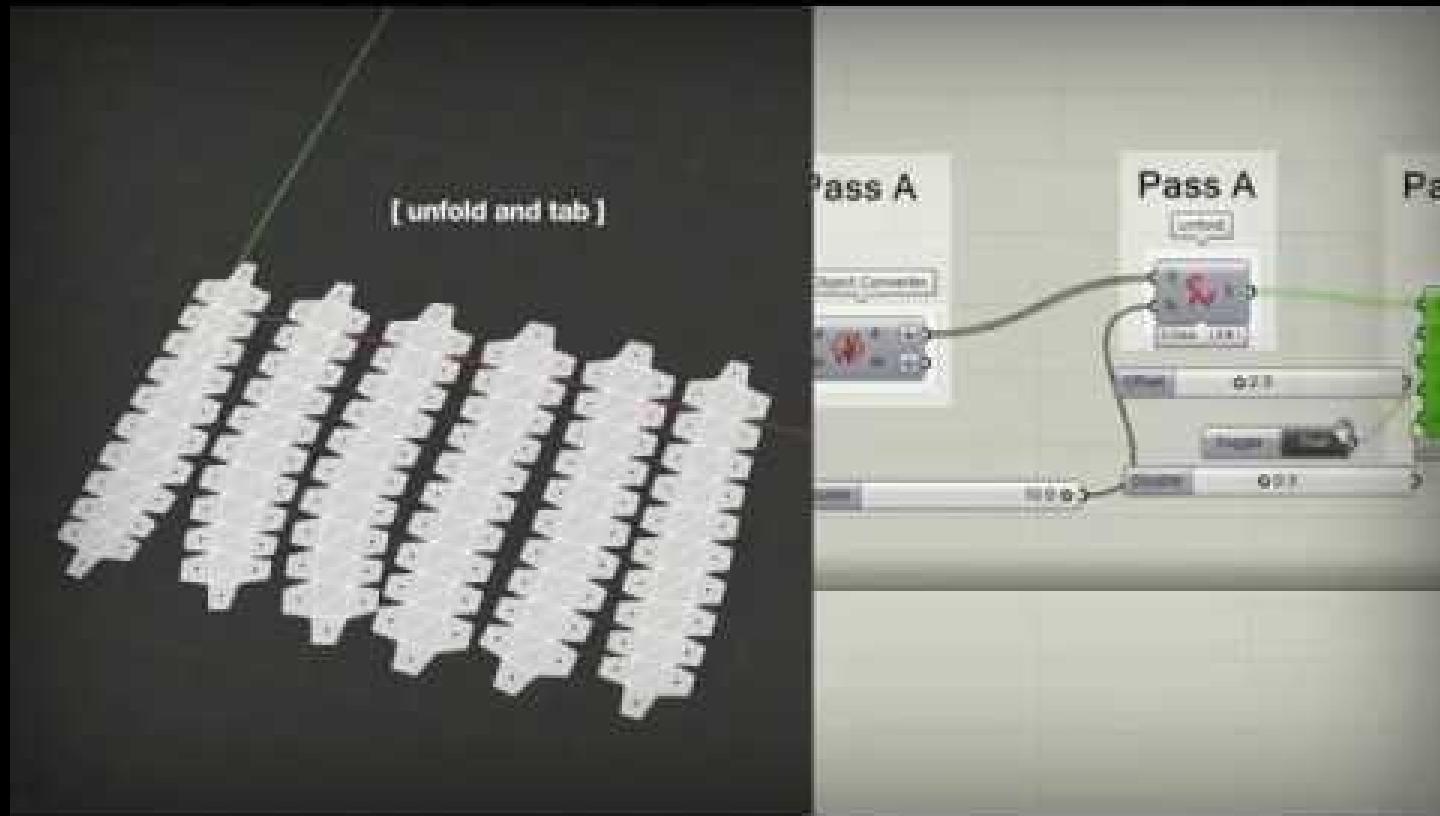
<https://namjulee.github.io/njs-lab-public/work?id=2015-ac-development>

<https://namjulee.github.io/njs-lab-public/work?id=2015-bending-scape>

Addon for GH

<https://www.food4rhino.com/app/architectural-compiler-digital-fabrication>





<https://namjulee.github.io/njs-lab-public/work?id=2015-ac-development>

# NJSTUDIO 2015 DIGITAL MOCKUP DEMO REEL

FIFTH EDITION, SELECTED WORKS SINCE 2004

njlee@gmail.com

www.njstudiolab.com

# MATERIAL & COMPUTATION

<https://namilee.github.io/njs-lab/public/work?id=2015-nano-micro-macro>

## TRMORESPONSIVE FABRIC AND BLIND

Nano Micro Macro: Adaptive Material Laboratory,  
HARVARD GSD

Date : Fall 2015  
Type : Academic project  
Prof. Martin Bechthold, James Weaver  
Role taken : design, research, computation and visualization  
Collaboration : Ji Hyuk Choi, Taehyun Jeon

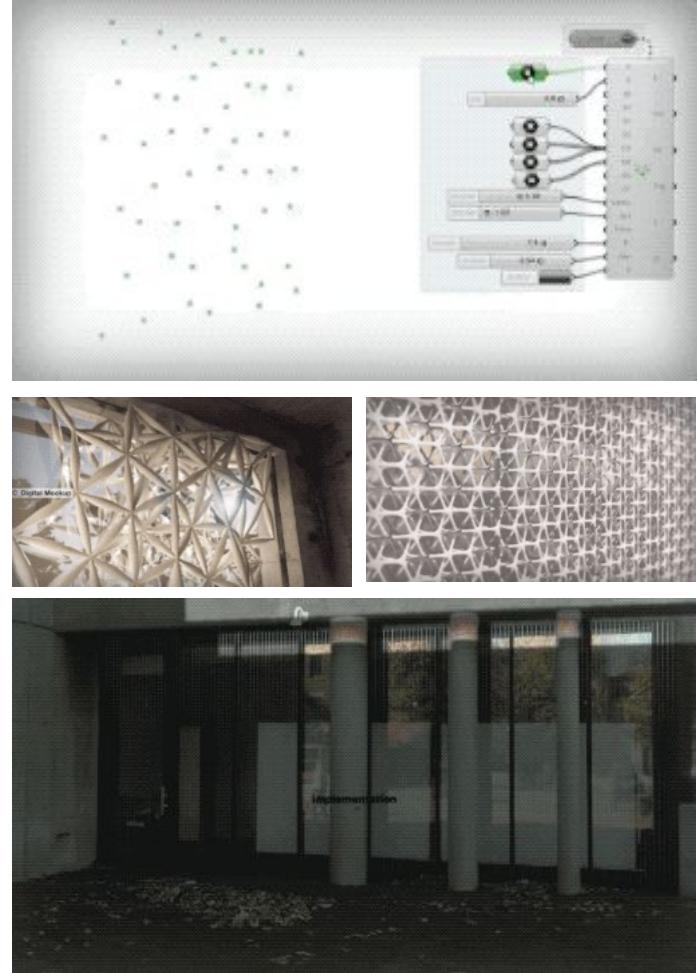
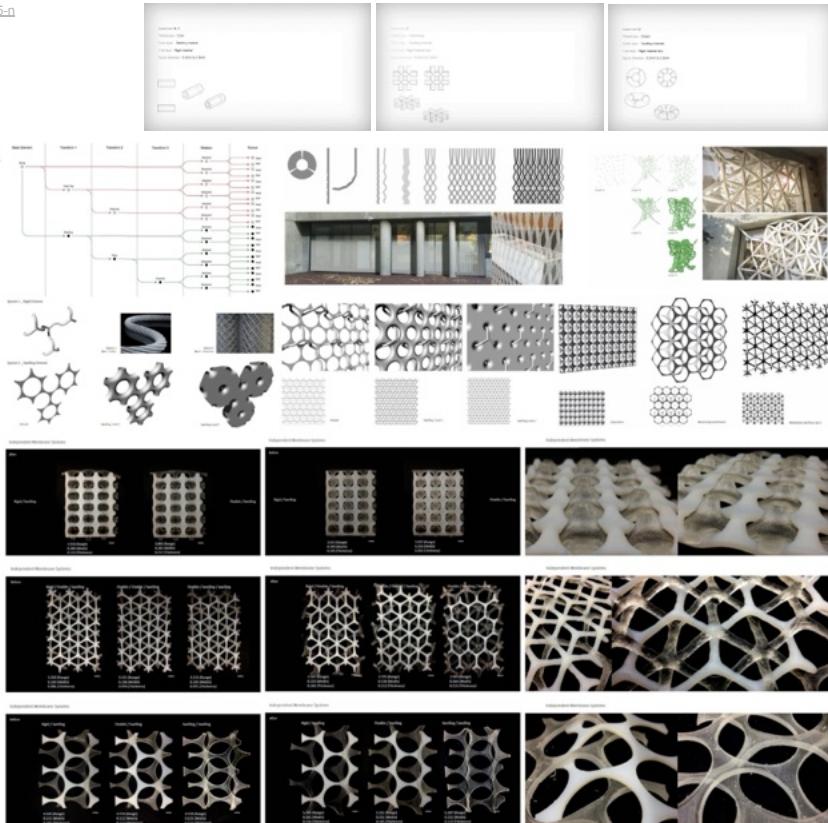
Website [Link](#)



**Concept**  
This design responds to thermal changes by varying the scale of porosities. The system consists of two separate membranes: one is rigid and the other is flexible. Based on the second membrane's swelling, cavities within the surface gets smaller to respond to outside thermal conditions.



**Material & Process**  
This experimentation is mainly done by 3d printing with the swelling materials. It will start with a simple cage for measuring the capacity of swelling toward more complex structures to maximize transformation by catalysis. Then, the computational model is created based on the measured data, and it was simulated in the digital setting.





<https://namjulee.github.io/njs-lab-public/work?id=2015-nano-micro-macro>

# FABRICATION & COMPUTATION

<https://research.gsd.harvard.edu/maps/portfolio/cewisama-2017/>

<https://namjulee.github.io/njs-lab-public/work?id=2017-cevisama>

## CERAMIC MORPHOLOGIES Cevisama Installation 2017 HARVARD GSD

Project Team: Professor Martin Bedrathold, Director; Salman Craig, Lecturer in Environmental Technology; Nono Martínez Alonso; José Luis García Del Castillo; Tiffany Cheng; Kevin Hinz; Namju Lee; Zhwei Liao; Matan Mayer; Saurabh Mhatre; Zach Seibold; Santiago Serna González; Juan Pablo Ugarte.

Role taken : computation design and visualization

Sponsor: ASCERtile of Spain & Cevisama

Coordinator: ITC, Javier Mira Pedro

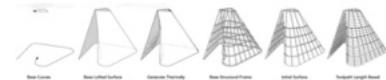
Production: Instituto de Tecnología Cerámica, Pilar Gómez Tena, Carmen Segarra Ferrando, Aroa García Cobos

Installation: Grupo on Market

Documentation: Fernando García del Castillo López

Link

Ceramic Morphologies explores the design opportunities of a novel ceramic 3d printing strategy. The project was developed by researchers and students from the Material Processes and Systems (MaP+S) Group at the Harvard University Graduate School of Design. Supplemented with production and material research by the Instituto de Tecnología Cerámica in Castellón, Spain, the project is a prototype for the additive manufacturing of ceramic building components at the industrial scale

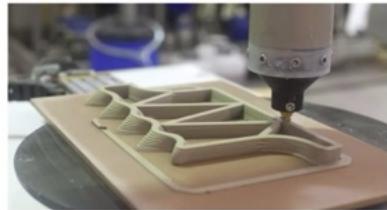


The pavilion is meant to showcase the expressive potential of ceramic 3d printing, and test the adaptation of principles of thermodynamic heat transfer to 3d printed geometry. The shape and design are products of current research related to the thermal performance of naturally ventilated spaces – the result of our collaboration with our colleagues Salman Craig and Matan Mayer from the Harvard Center for Green Buildings and Cities. While the exterior surface of the pavilion is smooth and uniform, the interior surface is heavily corrugated and 3d textured. In addition to creating a unique relationship between interior and exterior space, the purpose of this challenging surface relates to research on the optimal dimensions for thermodynamic heat transfer.

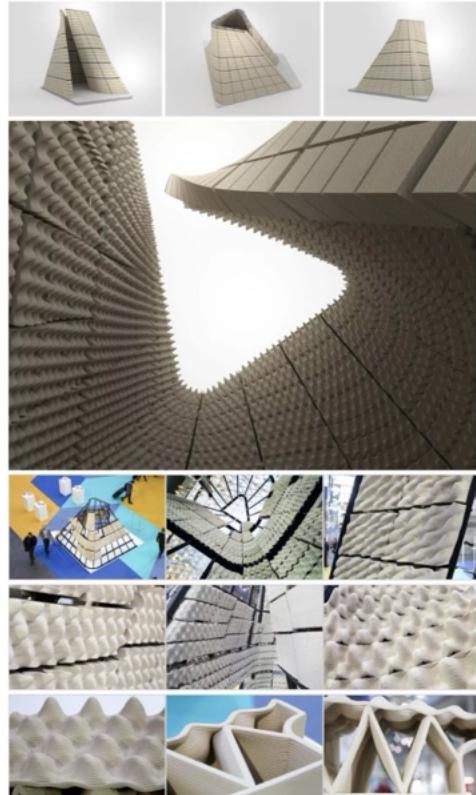


The thermal agenda is embedded in the logic of both the pavilion's interior surface geometry and the configuration of its overall form. Its pyramidal shape facilitates upward air movement, and the interior geometry impacts the thermal exchange between ambient air and the interior surface. The pavilion's curved, tapered profile of the interior surface is designed to optimize the ratio of surface area to thermal mass, and maximize the potential for cooling through natural ventilation and buoyancy effects. The project team has created mathematical models to predict the thermal behavior of the system.

The project utilizes a proprietary clay extrusion system and 3-axis armature to produce each of the pavilion's 552 unique ceramic elements. Each element is sized according to its position within the structure: the dimensional constraints of the printing bed, and a maximum allowable toolpath length. The team developed a novel computational approach to generate the surface geometry of the pavilion, discretize the form into individual bricks, and accommodate for the structural metal frame. The toolpath geometry and machine code is also generated directly within the parametric model. The digital workflow enabled the research team to account for shrinkage during the drying and firing process, reduce overall printing time and material consumption, and tune the stability of individual bricks.

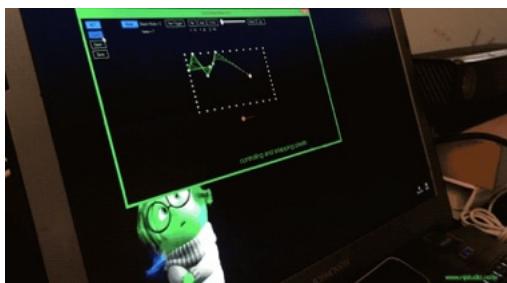
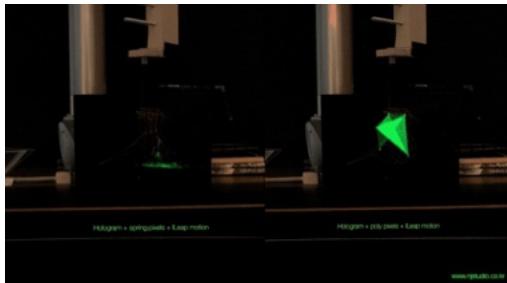


Measuring 3 m tall, with a footprint of 3.2m x 3.6m, the pavilion consists of 552 unique elements ranging from 260-545 mm in length, and 70-150 mm in height. 184 elements, representing 1/3 of the entire structure, are displayed in the current configuration shown at the 2017 Cevisama Fair in Valencia, Spain. Gaps between pieces allow for tolerances in the production. The modules can be bonded with mortar for permanent installations or, for temporary applications such as Cevisama 2017, can be dry-stacked and secured to a support frame. In total, the 184 printed elements displayed required 358 hours of printing time, and include 19.84km (12.33 miles) of extruded clay bead.



# INTERACTION & ROBOTICS

<https://namjulee.github.io/njs-lab-public/work?id=2015-sketch-hand-mechatronic-optic>



Harvard University (393)  
Mechatronic Optics (ID: 0045000)

SKETCHHAND  
SKETCHHAND

beta 0.0.5 , version for hologram

the use of data in design  
Materials, Tools, and Creativity  
**Data & Code and Design**

재료 & 도구 그리고 창의성  
**데이터 & 코드 그리고 디자인**



**Arithmetic >>> ! Addition**

# **NJCHANNEL PROJECT**

Education

# APPENDIX

## EDUCATION

<https://namjiilee.github.io/njs-lab-public/teaching>

Youtube English  
<https://www.youtube.com/channel/UCP4q3a4ogJN1-SbJcLR3Ww>

Youtube Korean  
<https://www.youtube.com/channel/UC3Z42une9C7Ef39h5cLK1dw>

Medium  
<https://n-j-namji.medium.com/>

<https://medium.com/me/stories/public>

Codepen:  
<https://codepen.io/NJStudio/collections/>

Daum Brunch (Korean)  
<https://brunch.co.kr/@njinamu>

Tistory (Korean)  
<https://computationaldesign.tistory.com/>

## Daum Brunch - link

NJ's Computational Design Series

초급: 익으면서 입문하는, 모두의 디자인 코딩

중급: 미라 하며 입문하는, 모두의 디자인 코딩

고급: 데이터 & 디자인 컴퓨테이셔널 디자인

처음 코딩을 접하는 디자이너에게 - [link](#)

NJ Channel Project, 콘텐츠 & 학습 자료 인덱스 - [link](#)



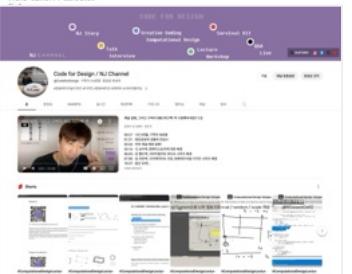
## NJSTUDIO project and portfolio channel

Date : 2011 ~ present  
Type : independent project  
Role taken : director  
[link](#)



## Education Channel

Date : 2011 ~ present  
Type : independent project  
Role taken : director



## Tistory - link



## Data & Design

[link](#) Jul 10, 2020 - 4 min read  
Computational Design, NJSTUDIO



<https://n-j-namji.medium.com/data-design-c21457d4dc6>

## Introduction to Computational Design: Data, Geometry, and Visualization Using Digital Media

[link](#) Jul 10, 2020 - 8 min read  
DigitalFUTURES WORLD : ARCHITECTS UNITE Workshops

Subtitle: Introduction to Computational Design for Geometry Visualization and Data Visualization for Digital Mapping on Web



Short Description:  
This is a hands-on workshop and lecture series about the Introduction to Computational Design for Data and Geometry Visualization for Digital Mapping on Web. For those who are interested in developing both the ideas and skills of data and geometry visualization to understand the data in architectural or urban contexts, this workshop is yours. The workshop consists of three key parts: (1) processing and visualizing data (2) constructing geometries (3) developing a pipeline for an interactive visualization.  
<https://n-j-namji.medium.com/introduction-to-computational-design-data-geometry-and-visualization-using-digital-media-14191fb6822>

## DATA STRUCTURE

Structured data - CSV, JSON, GSON — [link](#)  
Semi-structured data - XML, GML — [link](#)  
Image - Remote Sensing, DEM — [link](#)

Programmatic Paradigm - Prototype Classes  
Software design pattern - (1) 1D/2D/3D Pattern  
Inheritance (object-oriented programming) - [link](#)

<https://n-j-namji.medium.com/geometry-as-data-structure-and-visualization-49bcfdeaa3851>

## Computational Design Thinking for Designers

[link](#) Jul 10, 2020 - 2 min read  
Computational Design

The keywords could help designers to start thinking like a computational design specialist. Computational thinking in design asks you to take approaches resolve a small design problem while at asking you an extremely iterative process to fix a comprehensive design concern. These different levels of the approach become hurdles to understand computational design processes for designers.

The keywords could guide you, who have no computer science backgrounds, to deal with the dilemma, and you would be able to get a sense of understanding of developing computational design process in manifold circumstances in your design practices.

## THE QUESTION / IMAGINATION / HYPOTHESIS

Understanding Problem, Concern & Issue  
Declaring Issues & Outcomes  
Writing Instructions

## THE METHODOLOGY & APPROACH

From Whole to Parts & from Part to Whole  
from Simple to Complex & from Complex to Simple  
<https://n-j-namji.medium.com/computational-design-thinking-for-design-60223b0776>

## Geometry as Data Structure and Visualization

[link](#) Aug 17, 2020 - 3 min read

Introduction to Geometry as Data Structure and Visualization

Keyword  
Class, Computational Geometry, Data Structure, Projection, Remap, Interpolation, Generalization, Gentil Principles, Principles of Graphical Integrity, Berlin's Visualization design space

Lecture:  
1) File format(CSV, JSON, GSON, Image)  
2) Geometry as Data Structure  
3) Iterating, Interpolation, Generalization  
4) Object-oriented programming(OOP) pattern  
5) Visualization

## DATA

Structured data - CSV, JSON, GSON — [link](#)  
Semi-structured data - XML, GML — [link](#)  
Image - Remote Sensing, DEM — [link](#)

Programmatic Paradigm - Prototype Classes  
Software design pattern - (1) 1D/2D/3D Pattern  
Inheritance (object-oriented programming) - [link](#)

<https://n-j-namji.medium.com/geometry-as-data-structure-and-visualization-49bcfdeaa3851>

We are able to answer these questions below.

how to capture and process spatial data in design

<https://n-j-namji.medium.com/discrete-urban-space-and-connectivity-492b30bd0841>

## 6 Digital Mapping using ArcGIS JSAPI

[link](#) Jun 4, 2020 - 3 min read

DigitalFUTURES WORLD : ARCHITECTS UNITE Workshops

[link](#) Jun 10, 2020 - 4 min read  
Introduction to ArcGIS JS API and the Development of a Mapping App

Keyword  
Projection, Remap, Interpolation, Generalization, ArcGIS JS API, Gentil Principles, Principles of Graphical Integrity, Berlin's Visualization design space

Research Overview:  
• That's Your Mobility: Design & Consumers

• Lecture:  
1) Projection, remap, interpolation  
2) Generalization  
3) Understand modify Object-oriented programming(OOP) pattern  
Workshop: Codex, GitHub  
1) develop a mapping app with ZINAPP based on the borderplate code

Additional note:  
1) data visualization using d3  
2) data visualization using d3-charts  
<https://n-j-namji.medium.com/6-digital-mapping-using-arcgis-jsapi-6a626a208d024b>

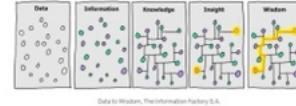
## Discrete Urban Space and Connectivity

[link](#) Jul 10, 2020 - 3 min read

Spatial Algorithms (2020) : Computational Design

Subtitle: Partition & Relationship

Keyword  
Data Structure, Graph, Matrix, Pixel, View, Discretization, Partition, Connectivity, Search  
Workshop Reference:  
1. Computational Design Thinking for Designers — [link](#)(Eng)  
2. Data & Design — [link](#)(Eng) — [link](#)(Kor)



# Introduction to Computational Design

Digital FUTURES World Workshop 2020

Tistory Search: <https://computationaldesign.tistory.com/167?category=937139>

Video Playlist - [https://www.youtube.com/playlist?list=PLuAvNvaGnDfEZ7qed18832U\\_MjSallmz2](https://www.youtube.com/playlist?list=PLuAvNvaGnDfEZ7qed18832U_MjSallmz2)

DigitalFUTURES Word link [https://www.digitalfutures.world/workshops-asia-econ5c-blipn/lee\\_kr](https://www.digitalfutures.world/workshops-asia-econ5c-blipn/lee_kr)

Medium link <https://medium.com/@namjulee/introduction-to-computational-design-for-mapping-and-data-visualization-1013a2a2a2d>

1 Python Basic

2. Data Visualization, RhinoGH Python

3. Typescript & HTML Canvas Visualization

4. Computational Geometry & Geometry Class & Visualization

5. Pipeline for Interaction, Data, and Geometry Visualization

6. Digital Mapping using ArcGIS JSAPI

## Introduction to Computational Design for Mapping and Data Visualization

Workshop Leader: <https://namjulee.com>

Workshop Details: <https://namjulee.com> (Please check your local time for compatibility and time zone differences)

Workshop Details: <https://namjulee.com> (Please check your local time for compatibility and time zone differences)



# Introduction to Design Visualization

Harvard GSD, MIT SA+P

Link - <https://namjulee.github.io/3d-visualization-harvard-gsd.github.com/>

Video - <https://youtu.be/3VeLfml2N-0>

Git - <https://github.com/Namjulee/Harvard-GSD-Workshop>

Download:

Content.pdf

Example files

BasicAnimation.pdf

BasicParticleSystem.pdf

## Workshop at Harvard Graduate School of Design

Please use this content only for educational purpose, not for commercial one

The aim of this workshop is to provide students with a knowledge of 3D visualization and Post-Production in architecture, landscape architecture and urban design domains.

- The rendering sequence files are excluded because they are simple too big.
- some files above 100MB are excluded because of the limitation. If you need to get entire exercise files, please contact me [nj.namjulee@gmail.com](mailto:nj.namjulee@gmail.com)



# DATA & DESIGN, JTEm at Harvard GSD

NJSTUDIO & NJSLab

<https://namjulee.github.io/njs-lab-public/data-for-design>

<https://namjulee.github.io/njs-lab-public/teaching>

A screenshot of the NJSTUDIO &amp; NJSLab website. The page has a dark background with white text. It features a navigation bar with links like "HOME", "ABOUT", "PROJECTS", "ARTICLES", "CONTACT", and "SUBSCRIBE". Below the navigation, there is a section titled "DATA &amp; DESIGN" with a sub-section "AT SCALE". Under "AT SCALE", there are several categories: "Urban Analytics &amp; Big Data", "Geometry Model", "Material Themes", "Computational Analysis", "Iterations", "Environment, Energy", "Material, Materials", and "Decision Making".

A screenshot of the NJSTUDIO &amp; NJSLab website. The page has a dark background with white text. It features a navigation bar with links like "HOME", "ABOUT", "PROJECTS", "ARTICLES", "CONTACT", and "SUBSCRIBE". Below the navigation, there is a section titled "DATA IN DESIGN &amp; AI FOR URBAN DATA &amp; VISUALIZATION" with a sub-section "CLASS INDEX &amp; HISTORY". Under "CLASS INDEX &amp; HISTORY", there is a list of items: "DATA &amp; DESIGN: AI FOR URBAN DATA AND VISUALIZATION", "DATA &amp; DESIGN: AI FOR URBAN DATA AND VISUALIZATION", "DATA &amp; DESIGN: AI FOR URBAN DATA AND VISUALIZATION", and "DATA &amp; DESIGN: AI FOR URBAN DATA AND VISUALIZATION".

## Index

Computational Design / Creative Coding

Open Lectures: NJ Channel 컨텐츠 & 학습 자료 인덱스  
No. 100 | 2020.03.22. 00:00 ~ 00:00

CODE FOR DESIGN



NJ CHANNEL: Membership Level 3 study guide

Introduction to Computational Design

1. Programming  
2. Computational Design: Meshes & Mesh Processing

3. Basic Geometry Data and Visualization  
-Polyhedron Meshes/Topological Meshes, Points, Line, Circle, Polyline, Polygon

Computational Design / Creative Coding

QnA: 문제 및 서비스 안내

QnA: QnA 및 FAQ

# Computational Design

## Lecture Series:

Tistory Search - <https://computationaldesign.tistory.com/3?category=937138>

NJ's Computational Design Lecture series - <http://bit.ly/2SqBRq0>

- 37. 우리는 무엇을 배우면서 사는가 **feat. 언어와 컴퓨터이서널 사고, 그리고 사고의 도약** - [link](#)
- 36. 코딩공부와 수학 그리고 공부할것 **Feat. 4차 산업혁명 그리고 디자인** - [link](#)
- 35. 함수호출 **By Reference, By Value** - [link](#)
- 34. 소프트웨어 어떻게 공부할까? 변할것 변하지 않을것, **Feat VR AR AI** - [link](#)
- 33. 디자인 엔지니어링 / **Design Engineering** - [link](#)
- 32. 궁극의 테크트리! 컴퓨터이서널디자이너로 살아 남기!! - [link](#)
- 31. SA 7.0 Lecture 5. 데이터 구조로서의 지오메트리 그리고 시각화 - [link](#)
- 30. SA 7.0 Lecture 4. 이산 도시공간과 연결성 (그래프)/Discrete Urban Space and Connectivity (Graph) - [link](#)
- 29. SA 7.0 Lecture 3. 캐드, 디이트의 흐름 / CAD data pipeline - [link](#)
- 28. SA 7.0 Lecture 2. 디자이너를 위한 컴퓨터이서널 퀘팅 / Computational Thinking For Designer - [link](#)
- 27. SA 7.0 Lecture 1. 데이터 & 디자인 / Data & Design - [link](#)
- 26. 금하기 어떻게 볼까? 추상을 통한 상상? 컴퓨터이엔크리에이티브 코딩 - [link](#)
- 25. 합합문화로 보는 새로운 패러다임 그리고 컴퓨터이서널 디자인의 운영 - [link](#)
- 24. 정규화 & 보간 & 이상치 / normalization & interpolation & outlier - [link](#)
- 23. 프로젝션 & 리맵 / Projection & Remap - [link](#)
- 서바이벌kit 11. 디자이너에게 코딩이란 / 나에게 코딩이란 / 코딩을 하는 이유 - [link](#)
- 22. 코딩공부 어떻게? (잔소리포함) / 제발 타이핑해보자!! - [link](#)
- 21. 내가 생각하는 컴퓨터이서널 디자인 / 워크숍 강좌를 만드는 배경 / 디자인 데이터 / Design & Data - [link](#)
- 20. 컴퓨터이서널디자인을 바라보는 시각과 오해 - [link](#)
- 19. 건축 3D 랜더링에 관한, 어느 건축가의 질문들... / 건축 시각화 - [link](#)
- 18. 애플 (건축, 도시) / Mapping for Urban and Architecture - [link](#)
- 17. 도시, 건축 랜더링 팀 / Architectural & Urban Rendering tips / 건축 시각화 - [link](#)
- 16. Mouse Event / 마우스 이벤트, CAD System - 캐드시스템 - [link](#)
- 15. Active Command - 엑티브 커맨드, CAD System - 캐드시스템 - [link](#)
- 14. Harvard GSD Technology 그리고 MIT Computation 지원준비, 프로그램 비교, 및 컴퓨터이전 공부 준비 방법 - [link](#)
- 13. 자료구조, 퍽셀, 복셀 / Data Structure for design , pixel and voxel data structure 2/2 - [link](#)
- 13. 자료구조, 그래프 / Data Structure for design , Graph 1/2 - [link](#)
- 12. 라이노 파이썬 / Rhino Python, 공부법 - [link](#)
- 11. HTML Canvas, 데이터 시각화, 크리에이티브 코딩 - [link](#)
- 10. 건축 시각화 / Architectural Visualization - [link](#)
- 09. 데이터 시각화 / Data Visualization - [link](#)
- 08. 디자이너를 위한 프로그래밍 언어 2/2 - Typescript(Javascript) - [link](#)
- 08. 디자이너를 위한 프로그래밍 언어 1/2 - C# - [link](#)
- 07. 파이썬 (Python) 배워야 할까? 잠단점을 알아보자! - [link](#)
- 06. 쉽게 이해하는 클래스(Class) - [link](#)
- 05. VR / AR 꼭 해야 할까? 2019 버전 - [link](#)
- 04. 건축 도시 디자이너를 위한 프로그래밍 테크트리 - [link](#)
- 03. 컴퓨터이서널 사고 (평가) / Computational Thinking - [link](#)
- 02. 파라메트릭 디자인? / Parametric Design - [link](#)
- 01. 컴퓨터이서널 디자인? / Computational Design - [link](#)

## QnA

Tistory Search - <https://computationaldesign.tistory.com/2>

Video Playlist - <https://www.youtube.com/playlist?list=PLweNVwGgDKEYzuT2sezSsQCP-me-1Tb7e>

### 3.1 디자인 그리고 컴퓨터이션

- QnA 01. 어느 고등학생의 질문 / 건축 파라메트릭 디자인 예제
- QnA 02. 건축가의 일반적인 질문 2차 (건축컴퓨팅실무)
- QnA 04. 건축컴퓨팅을 공부하고 싶으신 건축가형님과의 대화
- QnA 05. 코딩과 건축컴퓨팅에 관심이 많으신 건축가형님과의 대화
- QnA 06. 건축가의 일반적인 질문 (건축컴퓨팅실무용용)
- QnA 11. 어떤 절은 건축 디자이너의 질문
- QnA 15. 볼록(Voxel)과 컴퓨터이서널 디자인 그리고 건축 디자인
- QnA 16. 파라메트릭(Parametric Design)과 미적분
- QnA 17. 내가 생각하는 그래스하퍼(Grasshopper)의 단점과 개인적인 생각
- QnA 19. 파라메트릭 디자인 배우려면 어디서부터 어떻게 시작해야 하나요?
- QnA 21. 5G기술과 건축산업(설계 협업 및 시각화 VR), 정말 유용 하나?
- QnA 22. 내가 생각하는 그래스하퍼(Rhino Grasshopper)의 장점
- QnA 23. 디자인 소프트웨어 어떻게 공부할까? / 그 많은 것 언제 다 해요?
- QnA 24. 디자인 소프트웨어 어떻게 공부할까? 두 번째, NURBS, Mesh(Polygon)
- QnA 25. 디자인 소프트웨어 어떻게 공부할까? - 알고리즘 공부 방법 / 그리고 브런치!
- QnA 31. 대학생의 질문, 대학교, 대학원, 파라메트릭 디자인 스튜디오 어떻게 접근 할까?
- QnA 36. 파이썬 그리고 그레픽 플랫폼, 마아, 라이노...
- QnA 37. 프로젝트디자인 위한 코딩 그리고 3D 소프트웨어 공부 질문, 그리고 개인적인 생각
- QnA 43. SA 7.0 Unit 2 관련 질문 / 스스로 공부하는 방법

### 3.2 코딩

- QnA 33. 코딩 시작 시에, 필요한 수학? 과연 뭐가 필요할까?
- QnA 38. 너는 어떤 프로그래밍 언어를 쓰니?
- QnA 39. 데크나컬 아티스트 공부 방법? 책? 학원?
- QnA 44. 네이버 카페, 그래서 호퍼 웹진 질문 / 코딩을 공부하는 자세

### 3.3 인공지능, 데이터 그리고 시각화

- QnA 07. 데이터 시각화 도구(tools) 그리고 개인적인 생각
- QnA 12. 데이터 시각화가 꿈인 카이스트 학생의 질문
- QnA 14. 디자인(건축), 빅 데이터, 그리고 인공지능(머신러닝)에 대한 질문
- QnA 42. 시각디자인 전공, 학생의 질문, 데이터 시각화 어떻게 공부할 것인가?
- QnA 46. 지도위에 데이터 시각화, 어떤 제품으로 개발을 하면 좋을까?
- QnA 47. AI, ML(머신러닝), GL(그래픽), CV(비전), 컴퓨터이서널 전공을 시작하는 학생 질문
- QnA 08. 컴퓨터이션 직업군 및 준비 자세
- QnA 09. 작성상사가 내 미래에 도움이 될 때, 회사를 떠나야 하나? 촌에서 배울점
- QnA 13. 미국, 호주, 유학준비와 그에 따른 생각들...
- QnA 20. SOP 작성 유의사항 (취직 커버레터 / 자기소개서)
- QnA 26. 대학원 진학, 유학에 대한 질문, 그리고 개인적인 생각, feat MIT Media Lab
- QnA 28. 건축과 학생의 질문, 건축, 디자인 유학 준비 그리고 주관적 생각
- QnA 29. 건축 & 디자인, 포트폴리오 그리고 취직, 유학
- QnA 30. 건축 유학 & 학비 그리고 개인적인 생각
- QnA 32. 건축/컴퓨테이션/뉴미디어디자인 직업군, 어떻게 준비하면 좋을까요?
- QnA 34. 유학 고민 많을 때, 실내건축학과 전공자의 MArch 유학에 대한 고민
- QnA 35. 컴퓨터이서널 디자인 유학을 준비하는 학생의 질문
- QnA 40. 건축/컴퓨테이션 유학 그리고 파이썬 코딩 공부
- QnA 41. 데이터를 활용한 도시 설계? 공부 전략? 그리고 (MIT SENSEable City Lab 연구소)
- QnA 45. 컴퓨터이서널 직장 구하기? 마음가짐?
- QnA 48. 유학? 얻는 이익이 있나?
- QnA 49. 스페셜리스트가 되기 위한 어느 학부생의 전공고민

# Numeric Network Analysis

## SA 7.0 Unit 2

Daum Brunch : <https://brunch.co.kr/@nianmu/91>

Video Playlist - <https://www.youtube.com/playlist?list=PLweNViGdQREhGYBPPWxH4MsbJW245c58>

Medium : <https://nianmu.medium.com/numeric-network-analysis-post-covid-19-urbanism-6-ft-rule-de267886028>

유튜브 한국어 전체강좌(수업, 워크숍, 미팅, 프레젠테이션) – 플레이 리스트  
유튜브 영어 전체강좌(수업, 워크숍, 미팅, 프레젠테이션) – 플레이 리스트

원문 링크 Numeric Network Analysis: Post-COVID-19 Urbanism, 6 ft rule – link  
선수 공부 자료 – link

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우정현 박사 / Junghyun Woo / axuplatform@gmail.com

SA 7.0 Unit 2 한국어 강좌

0. Introduction Unit 2 – Medium link  
유닛 2 수업 소개 – 전체 버전 (Eng)

1. Lecture, Data and Design – Medium link  
데이터 그리고 디자인 – 전체버전 – 편집버전

2. Lecture, Computational Design Thinking for Designers – Medium link  
디자이너를 위한 컴퓨테이셔널 사고 – 전체버전 – 편집버전

3. Lecture, Pipeline for Interaction, Data, and Geometry Visualization – Medium link  
CAD 소프트웨어의 구조 그리고 데이터의 흐름과 시각화 – 전체버전 – 편집버전

4. Lecture, Urban Design Quality and Walkability – Medium link  
도시디자인과 보행환경 – 전체버전

5. Lecture, Spatial Network Analysis In Transportation Geography – Medium link  
교통계획 분야에서의 공간 네트워크 분석의 활용 – 전체버전

6. Lecture, Examples of Numeric Network Analysis using the NNA Toolbox – Medium link  
NNA toolbox을 활용한 도시 공간정보 분석 예시 – 전체버전

7. Lecture, Discrete Urban Space and Connectivity – Medium link  
이산 도시 공간연결성 – 전체버전 – 편집버전

8. Lecture, Geometry as Data Structure and Visualization – Medium link  
데이터 구조로서의 시공해설 그리고 시각화 – 전체버전 – 편집버전

9. Workshop, Pedestrian Volume Studies – Medium link / Post-COVID-19 Urbanism – Medium link  
보행자 이동성 정보 수집 방법 / 포스트 코로나를 대비한 도시 환경 계획 및 아이디어 – 전체버전

10. Workshop, Data Visualization, Numerical Image Utility  
데이터 시각화 / 이미지 둘 – 전체버전

### Discrete Urban Space and Connectivity

NJ Namju Lee Ad 10,2020 - 3 min read

Social Algorithms (2020), Computational Design

Subtitle: Partition & Relationship

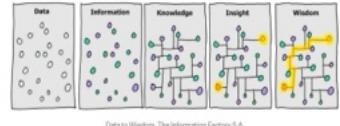
#### Keyword

Data Structure, Graph, Matrix, Pixel, Voxel, Discretization, Partition, Connection, Search

#### Workshop Reference

1. Computational Design Thinking for Designers – [link](#) (Eng)
2. Data & Design – [link](#) (Eng) – [link](#) (KR)

...



Data to Wisdom, The Information Factory S.A.

We are able to answer these questions below.

how to capture and process spatial data in design

Relationship among data in a space

Discrete a space into parts

#### 1. Graph

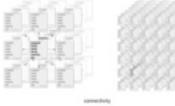


Graph is a mathematical object that consists of set of points and edges, dealing with discrete information.

Graph is widely used for computation, discrete

mathematics or representing relational data structures, and it has explicit relationship among vertices by edges visualizing the topological aspect such as street network of urban, highway or the subway map, whose graphs closely resemble their physical form due to its characteristics.

#### 2. Pixel / Voxel (Volumetric Element)



Voxel could be considered as a set of image(pixel)

Voxel is a 3 dimensional grid containing pixels can have rich data set including R, G, B, A values. It is frequently utilized for visualization of scientific or medical data which is needed for volumetric representation.

Voxel for geometry in space is a discretized space of geometry where it has a beam or node are connecting but as a continuous map in space. This is basically an idea that an object become a 3 dimensional map.

#### 3. Partition

Linear regression, KNN, Support vector machine, Random Forest, CNN, Temporaray Polygons

Delaunay triangulation / Voronoi diagram

Discrete space – Space Partitioning

Quad Tree / Octree / Bin System

Axi of ABBR / Distance

Clustering Points: Collision-Based Dynamic Graph method – [link](#)

#### 4. Connectivity

GRAPH – [link](#)

Graph Data Structure for Spatial data – [link](#) (KR)

Social network as Graph – [link](#)

Transportation as Graph (Street, freeway/highway, railway, sky way...) – [link](#)

Folder structure as Graph – [link](#)

Programming executions as Graph – [link](#)

Zoning as Graph – [link](#)

Associative geometry – [link](#)

Interface – [link](#) / [link](#)

Network for ML – [link](#)

Structure – [link](#) / [link](#)

Mesh(Polygon) as Graph – [link](#)

Mesh from Rhinoceros – [link](#)

NJSTUDIO Presentation slide

Data structure as Graph

JSON / GSON as Graph

Matrix ([link](#)) / Pixel ([link](#)) and Voxel ([link](#)) as Graph

# AI & Data for Design

Link: <https://computationaldesign.tistory.com/29>

AI and Data for design / 데이터 그리고 디자인 / 디자이너를 위한 인공지능

J-Term 2017, Harvard GSD :

Title: Introduction to Data Science for Building Simulation

1 Python Basic

2 Data process & Visualization

3 Train modes & Predict missing values

### Data Process

Numpy, Pandas, CV

### Workshop

Temperature Conversion

Multiplication Table 1. regression model 2. cnn model

Smart Drawing 1. Data process 2. Model A 3. Model B

Smart Commander

Semantic Segmentation

Third Place Prediction

Map Classifier

Super Resolution

Smart Map Tracer

Texture Prediction

Color Prediction

3D Volumetric Representation and Machine Learning in Design

### Python Basic

TypeScript Basic, Tensorflow JS

### Project

Project, Smart Map Tracer, ESRI Storymaps Hackathon – [video](#)

Project, Smart Drawing - Writing / Video / [Demo](#)

Project, Remixing and Resampling Three Dimensional Objects,

Use of Volumetric Representation and Machine Learning in Design - [link](#) / [video](#)

Project, Politics of Space and Its Shadows - [link](#) / [video](#)

Project, Built Environment Assessment - [link](#) / [video](#)

Analytical housing prediction model with spatial observation in City of Boston

link 4-Smart Drawing

link Linear-regression, Polynomial Regression , Regression Model , XOR

Codename - Tensorflow playground state, Typescript

# SEARCH

Design and Computation

The screenshot shows a search interface with a search bar containing 'vector'. Below it, the text '13 Lectures' is displayed. A grid of 13 thumbnail images represents different lectures or resources related to vector topics. The thumbnails include titles such as 'RhinoPython Q 09', 'Mapping Workshop', 'Data Visualization ArcGIS ISAPI & Canvas', 'Introduction to Solidity for Web - English', 'RhinoPython Q 14 파이썬 (Python) 질문 그리고 스터디의 목적(아이디어)', 'RhinoPython Q 14 파이썬 (Python) 질문 그리고 스터디의 목적(아이디어)', 'Surface Paneling', 'Curve Tool / 커브 수정자', and 'VectorField'. Each thumbnail has a small caption below it.

<https://namjulee.github.io/njs-lab-public/?search=vector>

# LLM

for Design and Computation

The screenshot shows a search interface with a search bar containing 'vector'. Above the search bar, the text 'LATEST UPDATE : N/A' is displayed. Below the search bar, the text 'ASK NJSLAB' is prominently shown. A message box contains the text 'Asking NJS-Lab for design and computation'. At the bottom, a note states 'The service will be available later. It's under the training....' Social media icons for LinkedIn, Facebook, YouTube, and others are at the bottom right, along with the copyright notice '© 2004 - 2023 NJSTUDIO All Rights Reserved'.

<https://namjulee.github.io/njs-lab-public/search>

# 대중과 미디어가 보는 미래

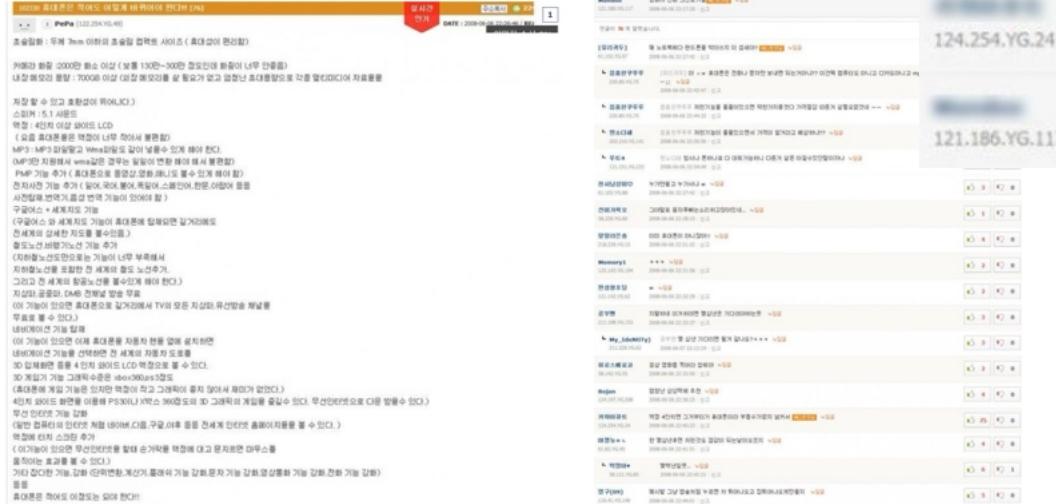
[일반] 다시보는 12년 전 스마트폰 예언 한류...jpg  
0 Ⓜ (211.3M) | 2020.05.20 10:00:02



Reference: [link](#)

61.102.YG.97  
2008-06-06 22:27:42 | 신고

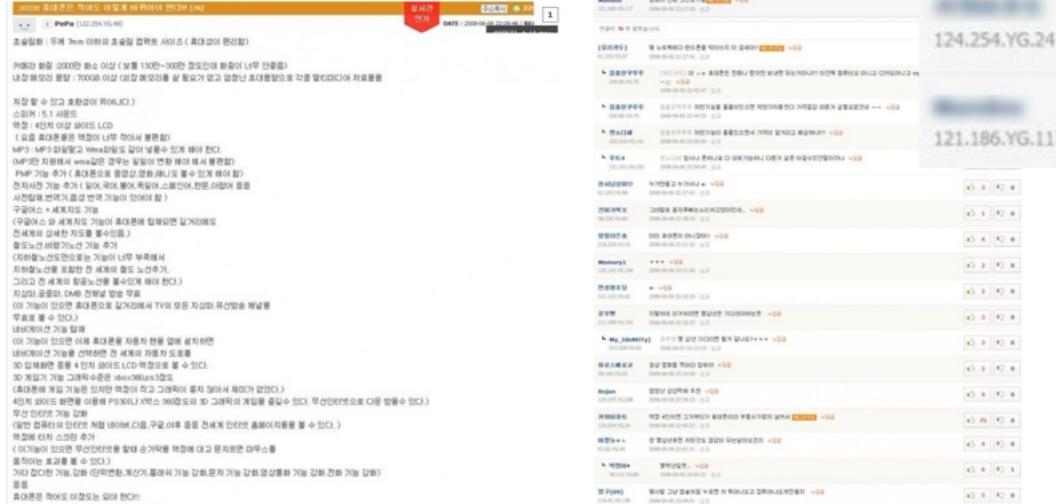
왜 노트북에다 핸드폰을 박아쓰지 이 [redacted]야? [\[노트북\]](#) [\[핸드폰\]](#) [\[신고\]](#)



Reference: [link](#)

124.254.YG.24  
2008-06-06 22:40:23 | 신고

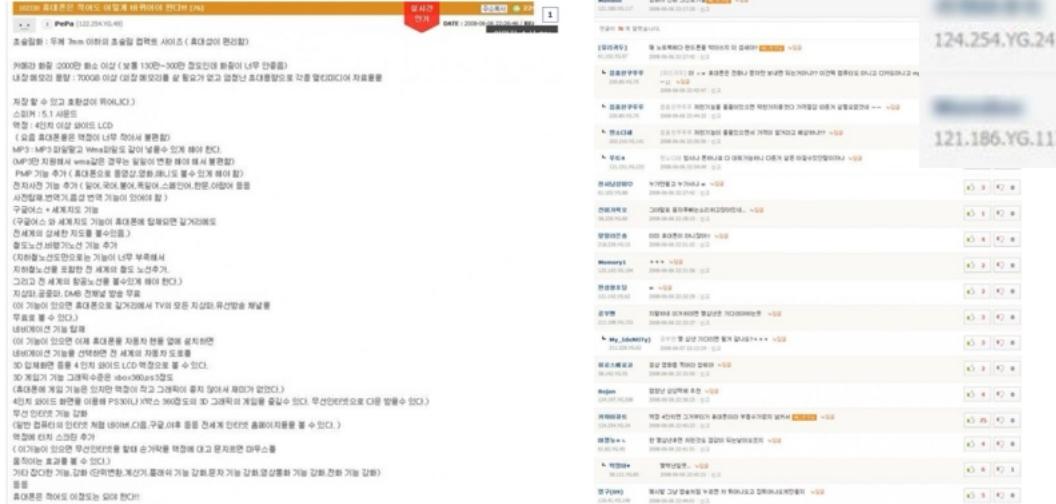
액정 4인치면 그거부터가 휴대폰이라 부를수가없지 넘커서 [\[액정\]](#) [\[4인치\]](#) [\[휴대폰\]](#) [\[신고\]](#)



Reference: [link](#)

121.186.YG.117  
2008-06-06 23:17:20 | 신고

영화나 만화 그만보기! [\[영화\]](#) [\[만화\]](#) [\[그만보기\]](#) [\[신고\]](#)



Reference: [link](#)

# 21 세기 데이터 기반 사회

## 1. 변화하는 것 & 변화하지 않는 것

“전략은 변하지 않는 것에 토대를 두어야 한다. 사람들은 나에게 5년 후나 10년 후 무엇이 변할 것인지는 묻지만, 무엇이 변하지 않을 것인지는 묻지 않는다.” 아마존의 창업자 제프 베조스(Jeff Bezos)는 말한다. 우리가 무엇을 예측할 때, 변하지 않는 것에 기초해야 한다.

Reference : <https://webzine.kps.or.kr/?p=4&idx=274>

서울여자대학교



[link](#)

연세대학교 특강



[link](#)



감사합니다 :)

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NJ Design Studio - <http://www.njstudio.co.kr>

NJS Lab - <https://namjulee.github.io/njs-lab-public>

github - <https://github.com/NamjuLee>

LinkedIn - <https://www.linkedin.com/in/nj-namju-lee-926b3252/>

Medium(Eng) - <https://nj-namju.medium.com/>

Daum Brunch(Kr) - <https://brunch.co.kr/@njnamju#articles>