

the use of data in design

디자인에서 데이터의 활용

DESIGNER & SOFTWARE ENGINEER & EDUCATOR



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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

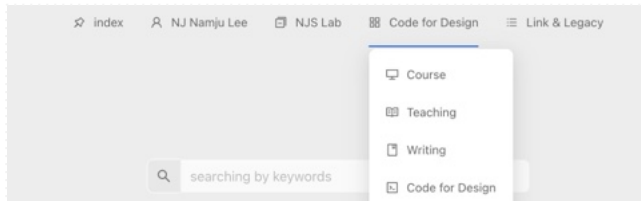
<https://namjulee.github.io/njs-lab-public/>

INDUSTRY & ACADEMIA



**NJSTUDIO &
NJS LAB**

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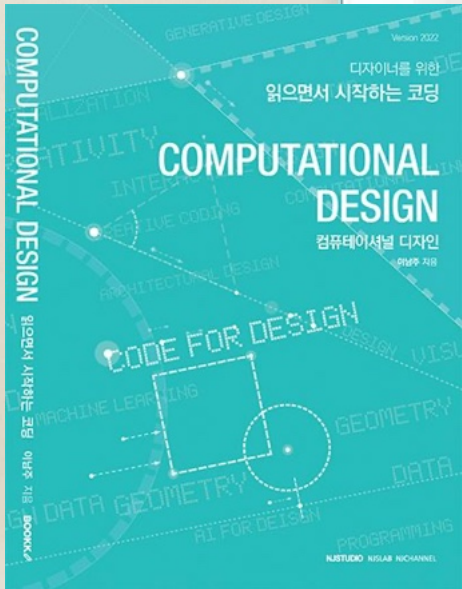
1,300 여 개의 영상 (강의 & 워크숍 & 상담 & 커리어전략),
150 여 개의 글(칼럼, 기고, 연구, 논문, 2권의 책), 140 여 개
의 직/간접적은 프로젝트, 연구, 개발, 340 여 개의 워크숍 자
료, 46 여 개의 수업들을 통해, 디자인과 컴퓨테이션 학습, 연
구, 활용에 대한 지식과 경험을 나누고, 산업의 전문가/프런티
어로서 그 역할을 충실히 해오고 있습니다. (2024년 9월 기
준: 조회수 453,616명, 조회시간 25,200시간 / 1,050일)



읽으면서 시작하는

디자이너를 위한 코딩

Computational Design



- Daum Brunch - <https://brunch.co.kr/@njamaju/144>
- Book - <https://www.bookk.co.kr/book/view/130128>
- EBook - <https://www.upaper.net/njamaju/1148626>
- Audio book - <https://www.youtube.com/playlist?list=PLu6N1VrGpDkEh7R0pAPF4pU63Lue83>

읽으면서 시작하는 디자이너를 위한 코딩

! 언어와 사고의 도약

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

구어체

먼 과거도 비슷하지만 가깝게 6.25 전쟁을 겪으신 우리 할머니, 할아버지 시대에는 대부분의 사람들이 학교에서 언어들(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 외곽이 편만할 수밖에 없는 시대로 볼 수 있죠. 이러한 문화, 시대성, 사고체계가 그 시대의 인텔리전스로 남았던 것이지요.

문자체

경제가 발전하면서 교육 수준과 열의가 높아지며 새로운 세대가 나타나기 시작했죠. 대부분의 사람들이 고등학교까지 의무 교육을 보편적으로 이수하며 문맹이 사라졌고, 보다 많은 사람들이 다양한 언어들을 높은 수준으로 이해하며 지식과 학습을 할 수 있었죠.

과거 구어체를 사용하는 것보다 문자체를 활용하는 것이 지식과 경험을 더 정확하게 전달하고, 학습하고, 실제 적용함을 좀 더 용이하게 했다고 볼 수 있죠. 경제발전이 따라 변하는 새로운 사회 요구를 충족시키기 위해 무리 없이 학습하는 것이 가능해졌고, 지능이 도약한 시기로 볼 수 있어요.

논리체계

2000년도를 넘어가며, 대학교... 하면서 또 한 번... 지조, 사...

Computational Design

에 요구되는 보편적 언어와 지식을 넘어, 전공지식 언어를 습득하며 보다 전문화, 체계화된 지식들과 논리체계는, 분명 기초지식만을 학습하는 시대보다 더 높은 수준의 사고를 완수할 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 봐요. 인터넷의 발달로, 굉장히 높은 수준의 정보를 과거보다 손쉽게 접근할 수 있을 뿐 아니라, 그 지식을 소화할 수 있는 논리체계도 물론 해졌다고 볼 수 있어요.

정보 보존과 전달 그리고 엄밀성

분명 과거보다 지식수준은 높아졌고, 정보의 손실을 최소화하며, 그 지식을 프로세스할 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? 지금의 시대를 바꾸고 이끌어 가는 핵심 영역들에서 우리가 습득할 수 있는 언어와 논리체계는 무엇일까요?



어떤 사고의 힘이 사회의 지능을 또 한 번 도약시킬까요? 필자의 개인적인 생

태를 소개하는 QR 코드 [컴퓨터이셔널 디자인 37. 우리는 무엇을 배우면서 사는가? feat. 언어와 컴퓨터이셔널 사고, 그리고 사고의 도약]을 통해 더 자세히 공유할게요.



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

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디자인에서 데이터의 활용

DISCRETIZATION for SPATIAL INFORMATION & CODIFICATION of DESIGN_(DECISION-MAKING PROCESS) and METHODOLOGY

공간정보의 이산화 & 디자인 프로세스의 코드화

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Architecture design, Computation, Visualization specialist

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MDes;Harvard, MArch;UCB, B.S.;SNUST, Research Fellow; MIT

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Director and founder of

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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
...

DATA at

geometry

architecture

urban

landscape

computation

visualization

material

GIS

Interaction

building energy

fabrication

...

이러한 데이터를 중요하게 생각할 때, 사회, 문화, 경제 등 우리의 삶은 일과 산업을 바꾸는 차원에 국한된 것이 아닌, 사회, 문화, 경제 등 우리의 삶에 친근본적인 변화를 가져올 패러다임이라 웅변하고 있어요. 즉, 데이터 기반 사회로의 도약인 것이죠. 이러한 패러다임의 변화 앞에, 디자이너는 무엇을 해야 할까요? 그 시작은 작금의 패러다임의 관점으로 데이터라는 재료를 다시 면밀히 살펴보고, 이해하는 것이 그 첫걸음이 될 수 있다고 생각해요.

1.4 데이터: 현상의 압축 & 통찰의 향연

데이터^{Data}는 현상의 표상^{Representation}으로 볼 수 있어요. 현상을 계산 가능한 형태로 추상화^{Abstract}시켜 압축된 디지털 정보문서로 볼 수 있어요. 다른 말로 사실^{Fact}, 혹은 현상의 단면을, 정성^{Qualitative}화 정량^{Quantitative}화 관계성으로 통찰^{Insight}의 형식으로 드러나게^{Revealing} 하는 것이죠.

로우 레벨의 기술적인 설명은 뒤의 챕터에서 자세히 나누고 하이 레벨 측면에서의 데이터를 더 살펴보죠. 사회의 패러다임이 제조업에서 플랫폼과 서비스 산업으로 바뀌면서 데이터는 정보산업에 석유와 같은 존재가 되었고, 하드웨어 인프라스트럭처, 컴퓨팅 파워, 소프트웨어

“A geographic information system (GIS) is
a conceptualized framework that provides the ability
to **capture** and **analyse spatial** and **geographic data.**”

Quantitative & Qualitative

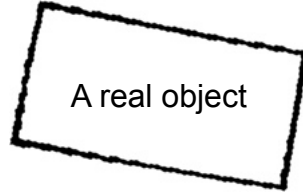
DATA

Vector

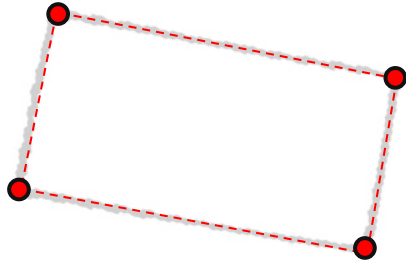
&

Raster

Vectorization & Rasterization



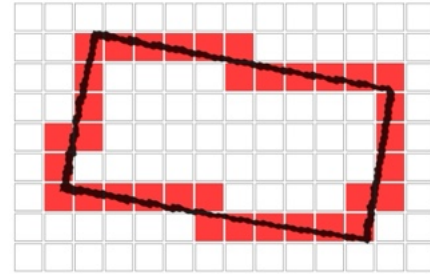
Vector



```
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  [50]  
] [ pos: [100, 50, 0],  
   radius: 50  
]
```

&

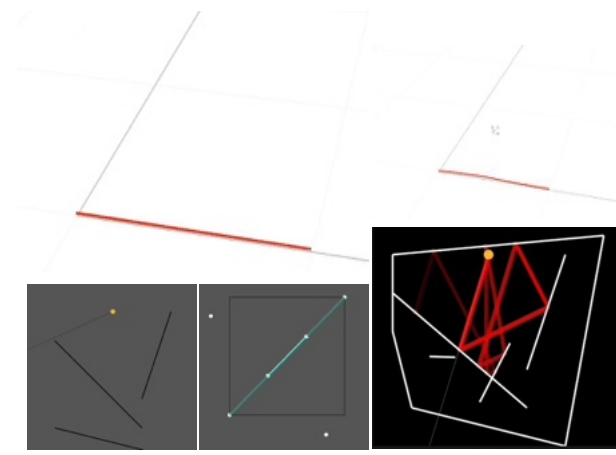
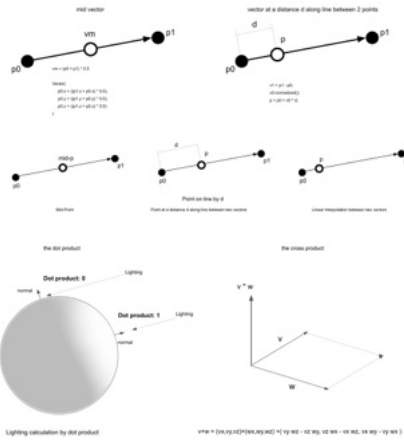
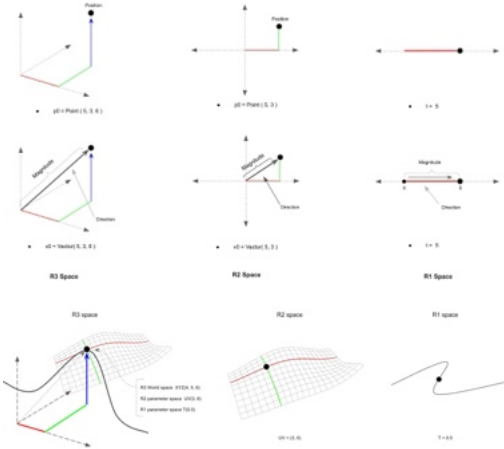
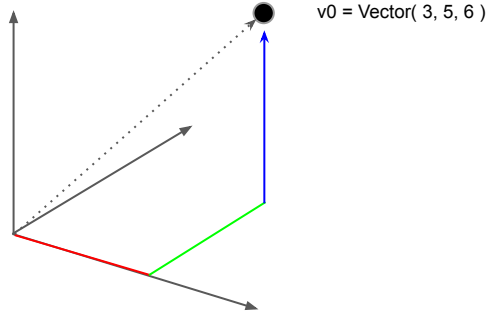
Raster



```
[ [ 0, 0, 0, 1, 0, 0, 0 ],  
  [ 0, 0, 1, 0, 1, 0, 0 ],  
  [ 0, 1, 0, 0, 0, 1, 0 ],  
  [ 1, 0, 0, 0, 0, 0, 1 ],  
  [ 0, 1, 0, 0, 0, 1, 0 ],  
  [ 0, 0, 1, 0, 1, 0, 0 ],  
  [ 0, 0, 0, 1, 0, 0, 0 ],  
]
```

Vector

Cartesian (Euclidean) Plane R3

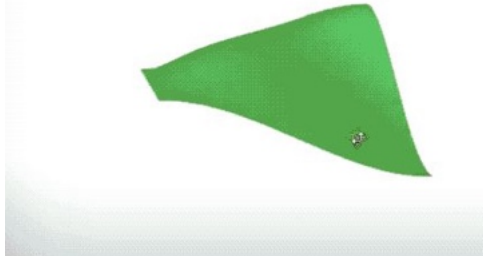


<https://www.khanacademy.org/a/3d-vector-notation>
<https://www.khanacademy.org/a/3d-vector-notation>
<https://www.khanacademy.org/a/3d-vector-notation>

<https://namijulee.github.io/nis-lab-public/work?id=2015-ngu-development>

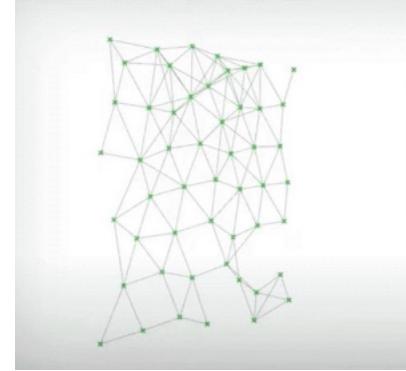
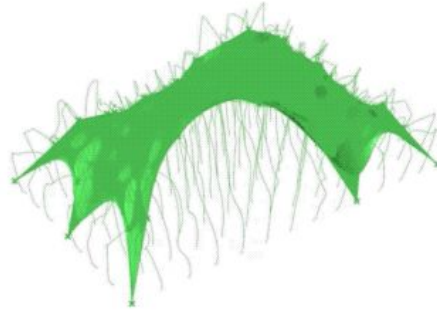
Geometry, Addon for Grasshopper
<https://www.food4rhino.com/app/numerical-geometry-utility>

Dynamics, Addon for Grasshopper
<https://www.food4rhino.com/app/numerical-mapping-utility>

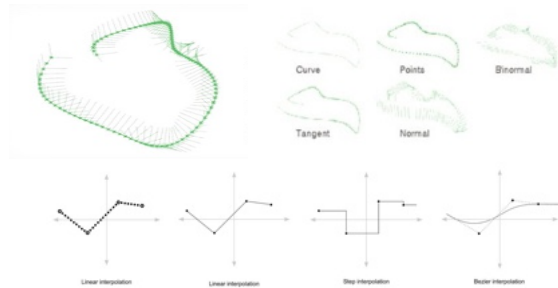
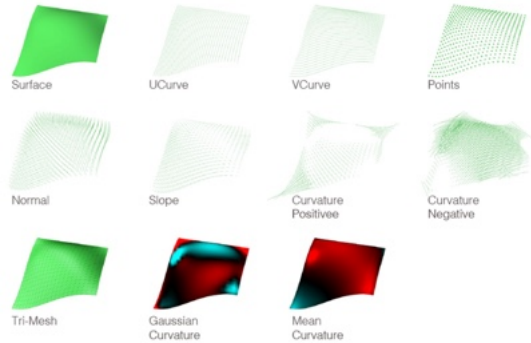


Geometry as Data Structure [link](#)

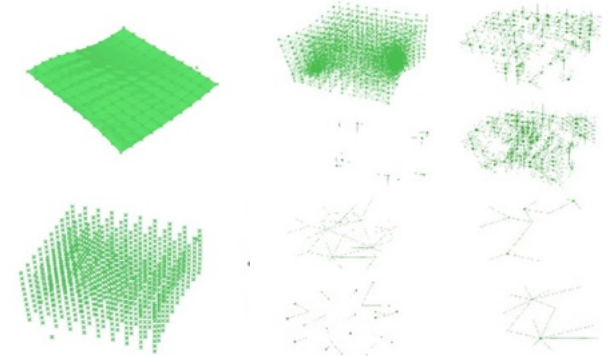
DYNAMICS



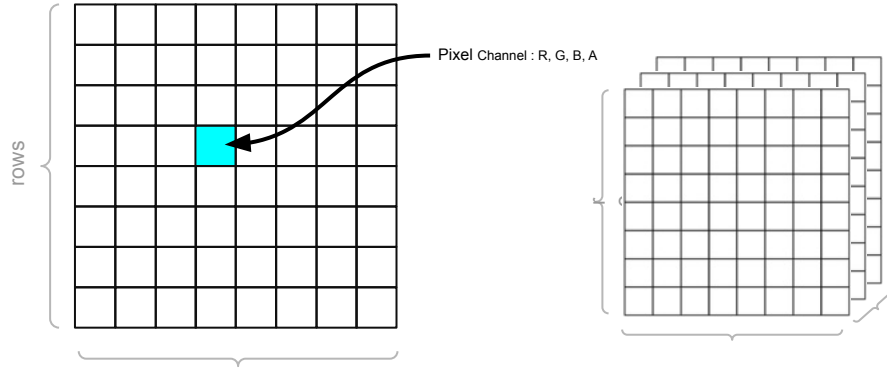
Data extractions



Connectivity



Raster



- Building: [210, 6, 42]
- River: [240, 100, 1]
- Street: [40, 13, 35]
- Grass: [117, 27, 34]
- Tree: [80, 22, 21]
- ...



```

[[[ 91 97 83]
  [ 82 90 69]
  [118 107 89]]]
...
[[ 98 98 96]
 [ 96 97 101]
 [101 101 101]]]
...
[[ 87 100 70]
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...
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...

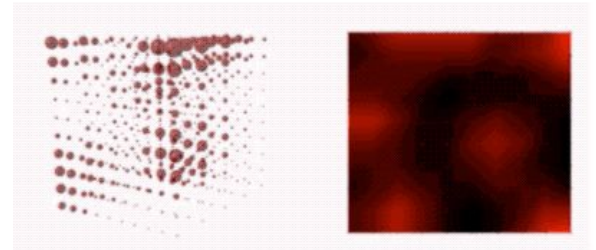
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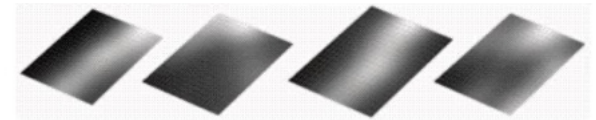
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 [ 64 68 54]
 [ 92 89 80]]]
...
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 [103 104 98]]]
...
[[ 83 82 64]
 [ 69 71 58]
 [ 79 85 75]]]
...
[[ 51 52 54]
 [ 91 90 86]
 [ 82 79 74]]]
...
[[ 98 92 76]
 [ 97 95 80]
 [ 84 90 80]]]
...
[[ 69 70 62]
 [ 78 82 81]
 [ 94 93 98]]]
...

```

Voxel Structure



Layers

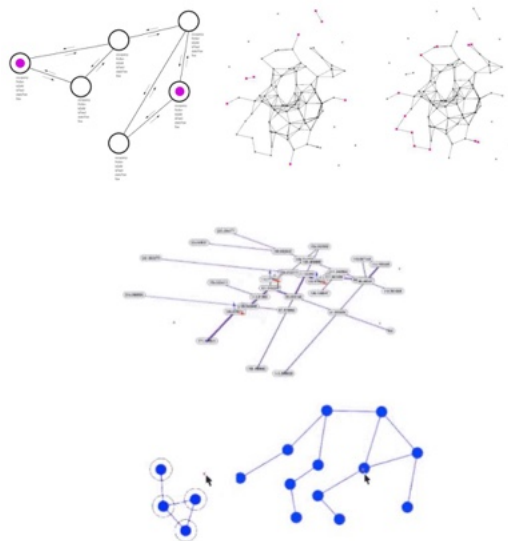


DATA STRUCTURE METHODOLOGY

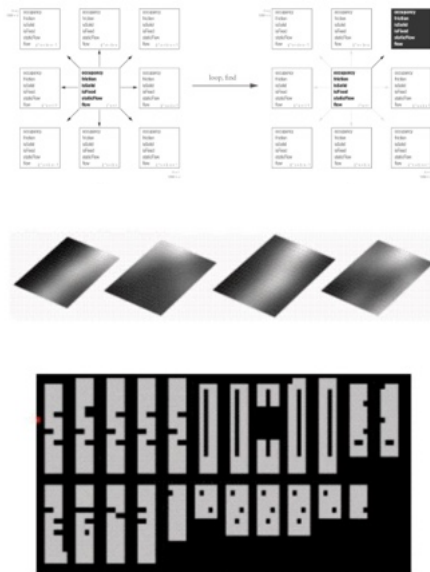
[Data Structure and Algorithm for Design and Research Workshop](#)

Type of Abstraction & Discretization & Resolution

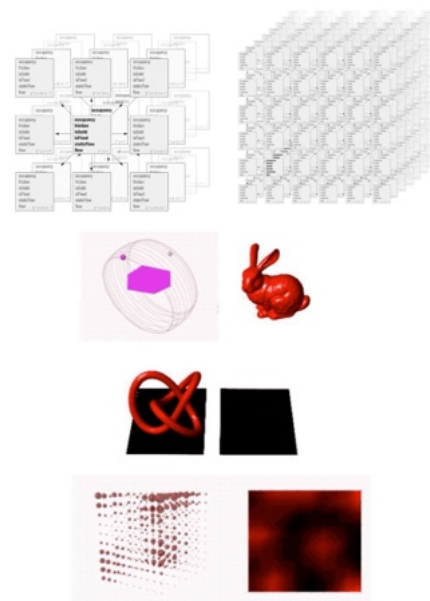
Graph [link](#)



Pixel [link](#)



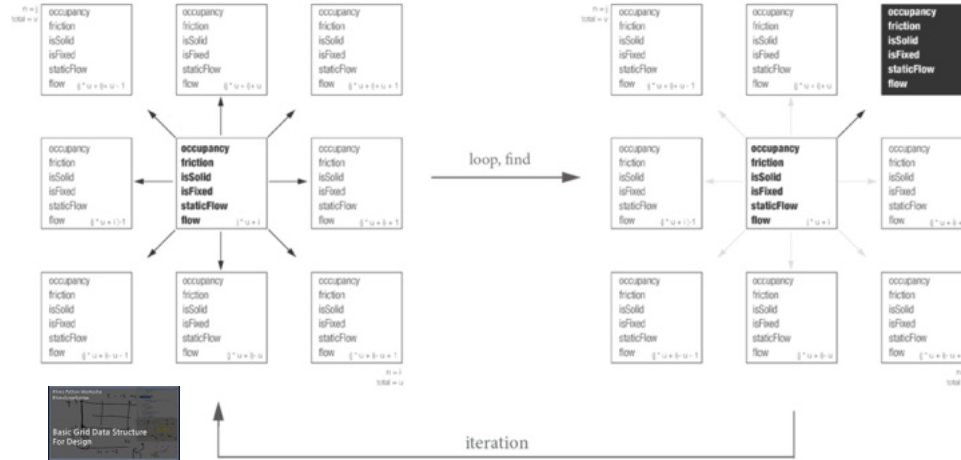
Voxel [link](#)



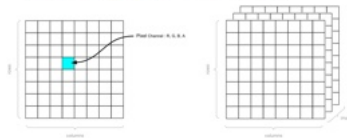


Raster Data Structure

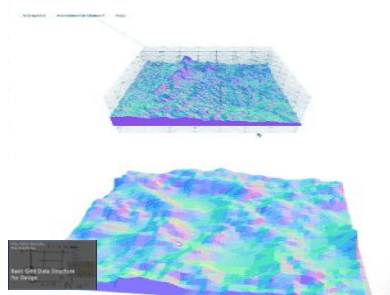
Grid System



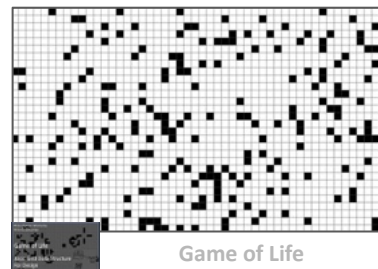
Discretization & Resolution



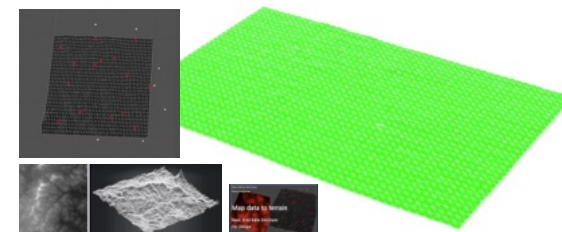
Grid Mesh



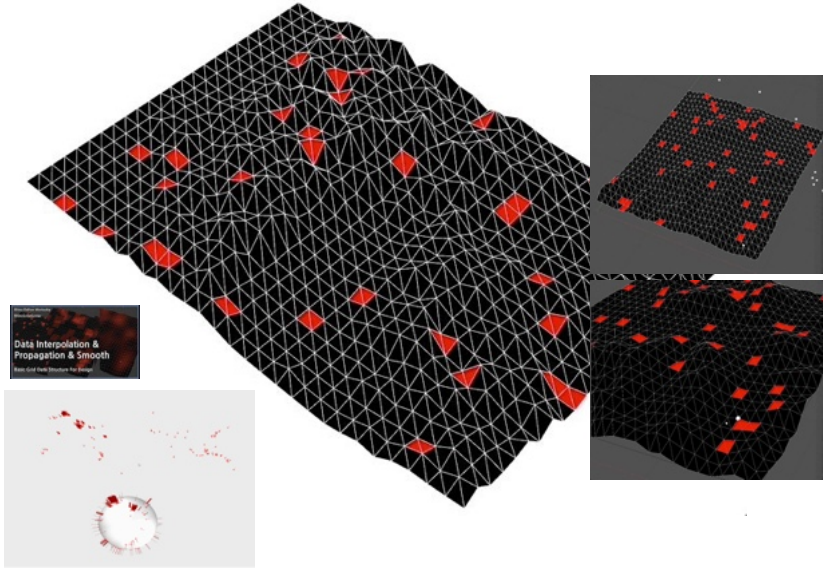
Connectivity



Data to Terrain



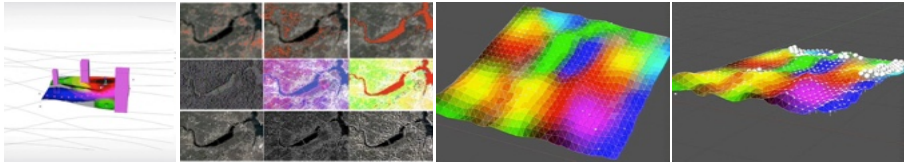
Propagation



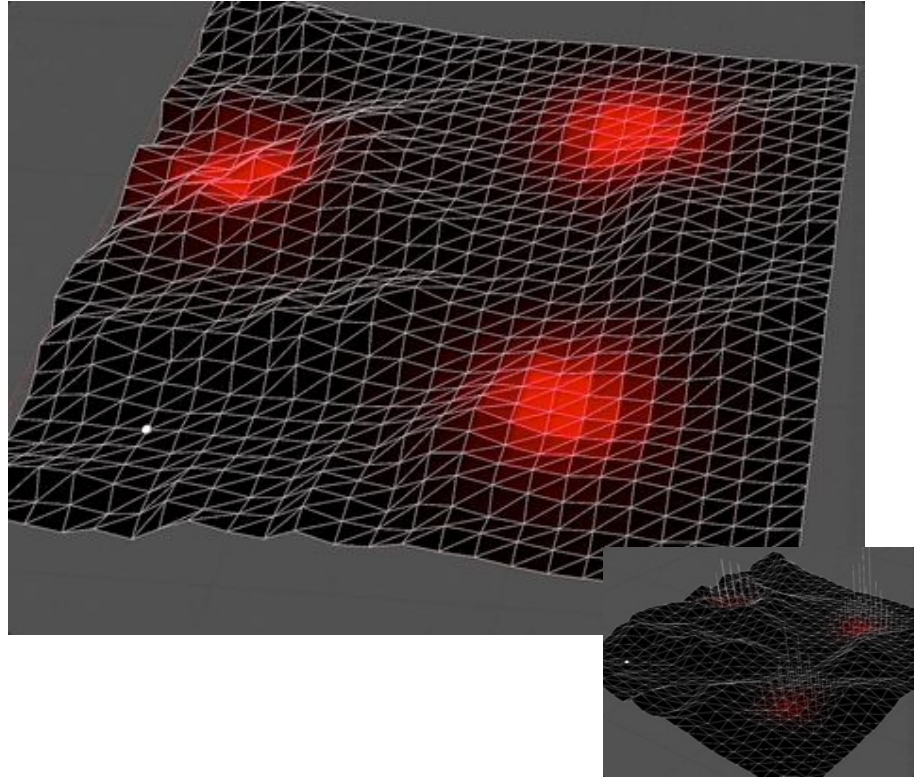
Data Interpolation & Propagation & Smooth

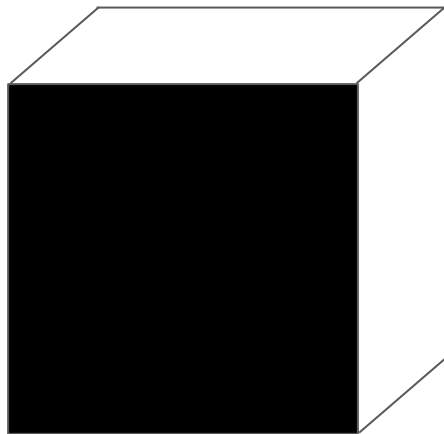


Data Channels



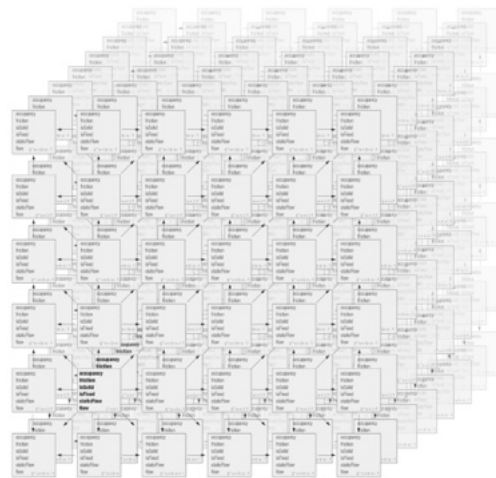
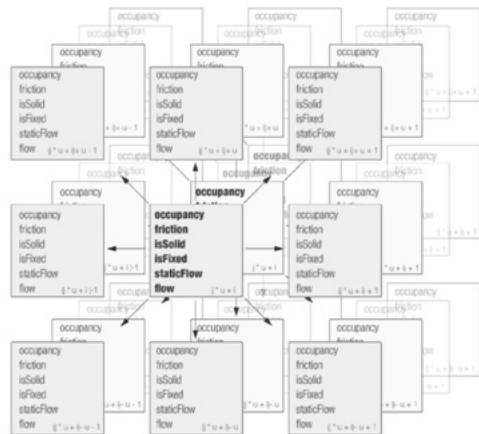
Data Falloff & Smooth



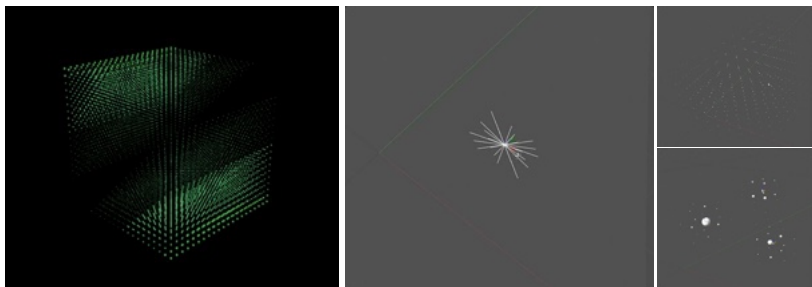


Voxel Map Data Structure

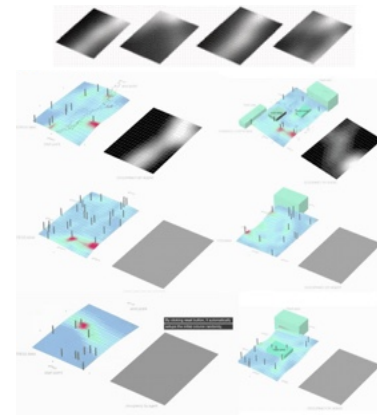
Voxel



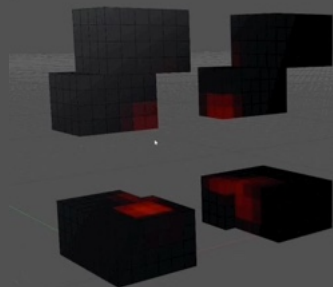
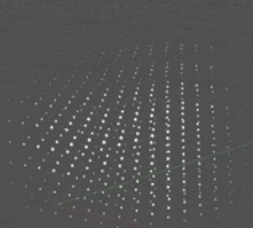
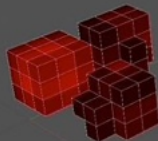
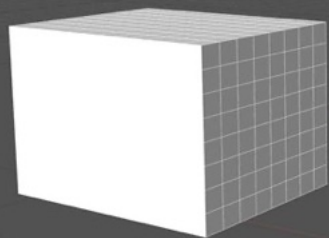
Connectivity



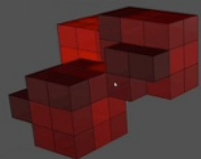
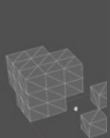
Data Interpolation



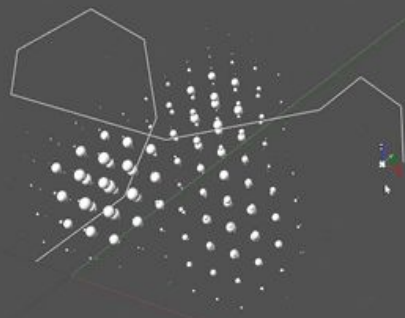
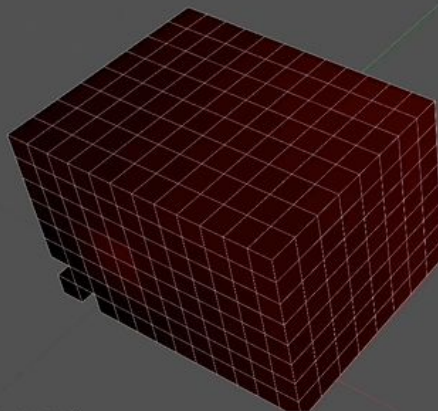
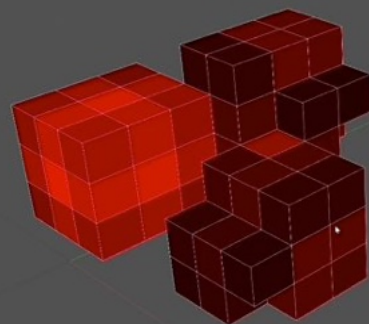
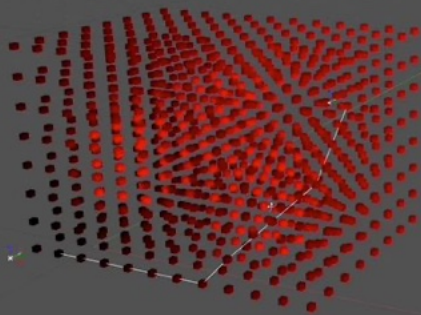
Voxel Data Visualization

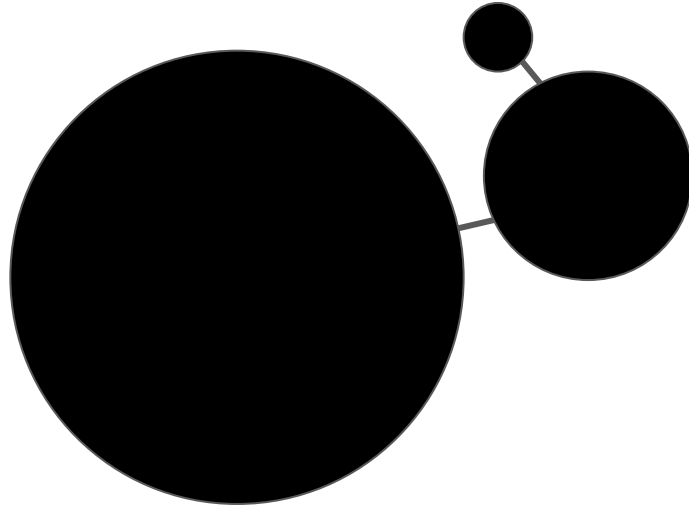


Voxel Mesh



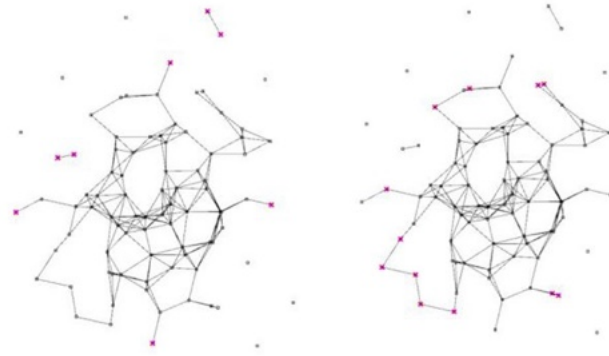
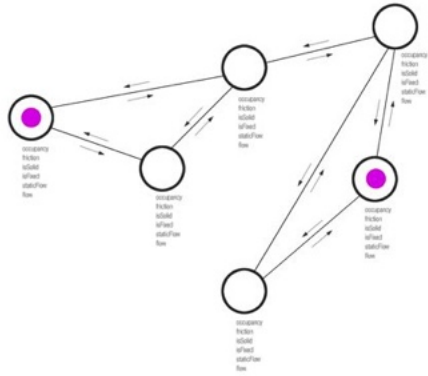
Voxel, Path Finding





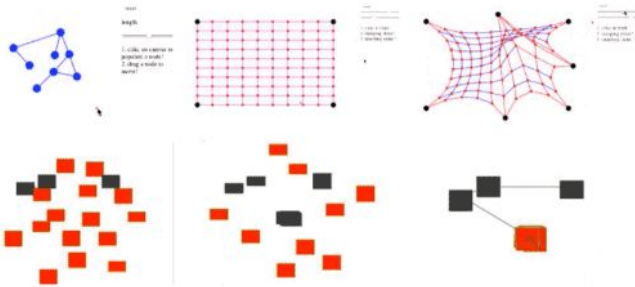
Graph Data Structure [link](#)

Graph



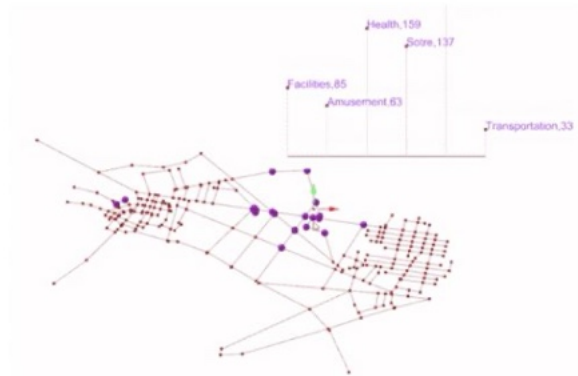
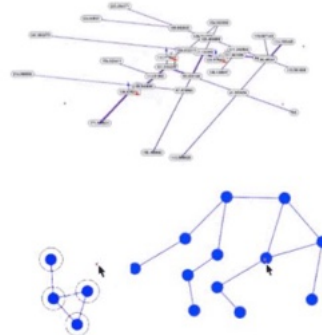
Graph Analysis

DYNAMICS

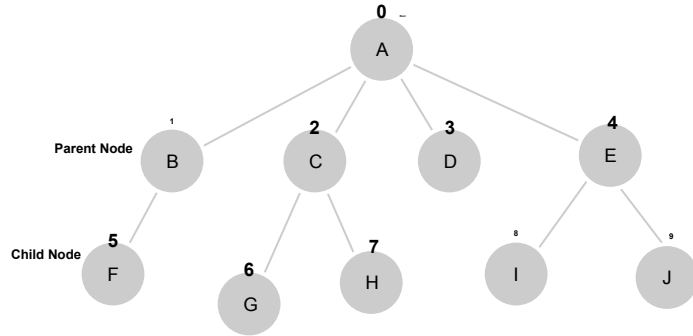


Network Analysis

DYNAMICS

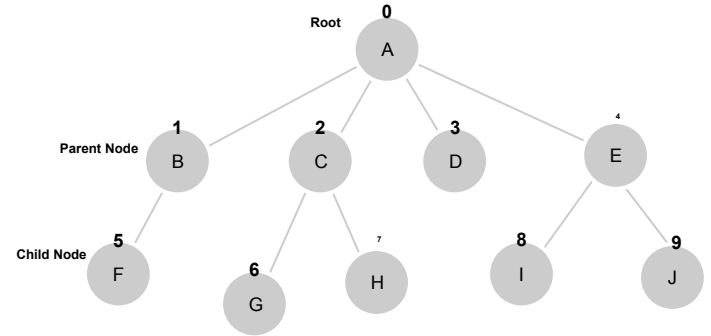


Graph & Pixel & Voxel Search & traversal



DFS
Depth First Search Using a Stack

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

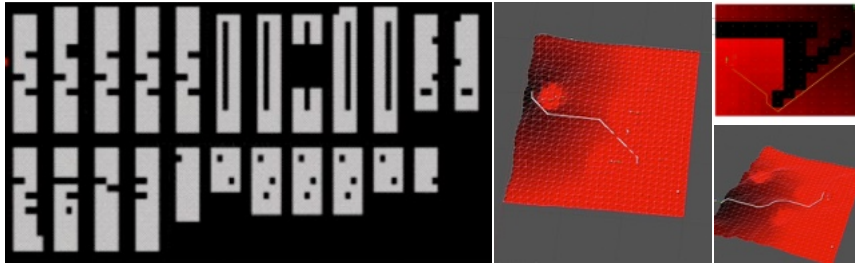


BFS
Breadth First Search Using a Stack

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

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

Path Finding & Dijkstra

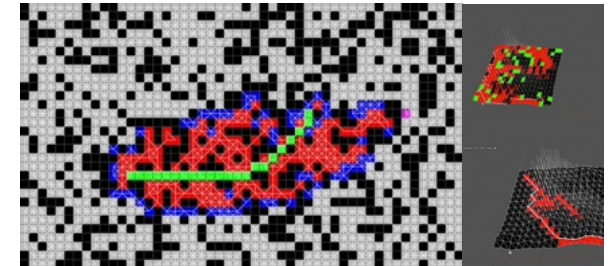


Reference:

https://docs.google.com/presentation/d/1P-G6-dP1-JaMfEgGzYvTH8K4-WVr1P83s1P2PvWvW3Uj0u0r0t0l0d0_e1b3z001304_8_200

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

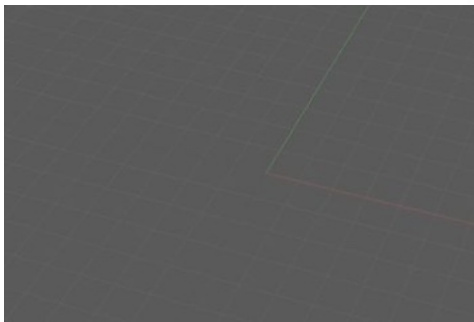
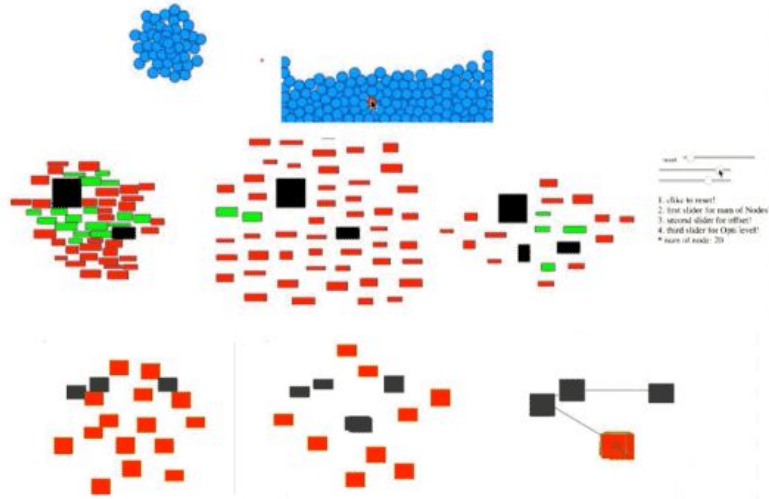
PathFinding A* concept



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

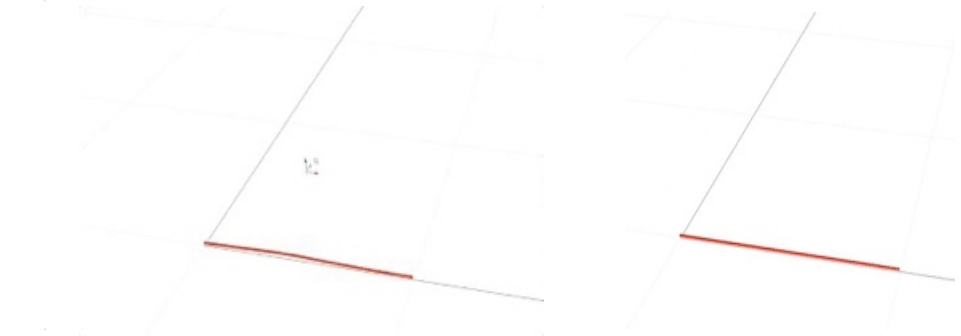
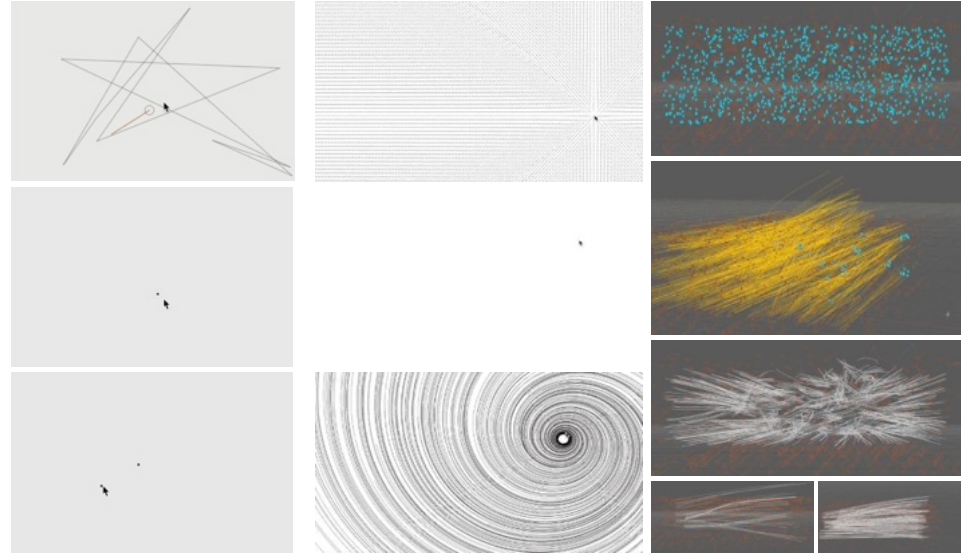
Particle

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

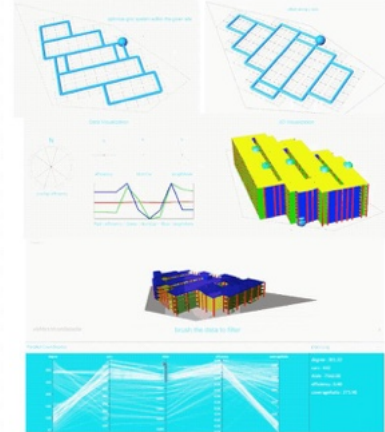
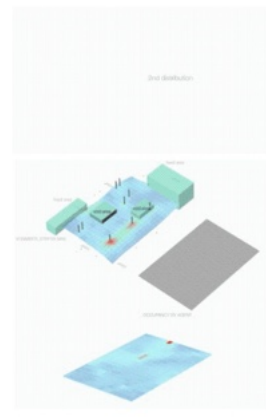
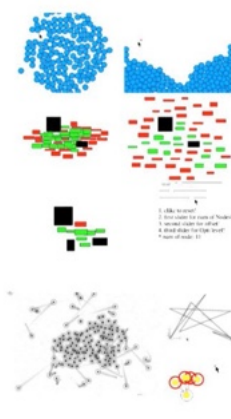
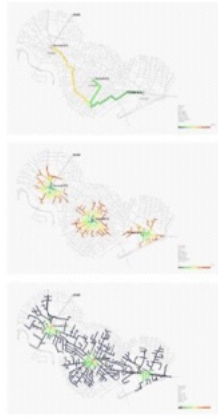
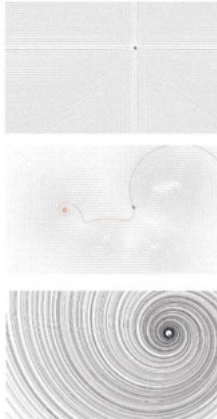
Interaction in design

Data driven decision making process

Complex system in design

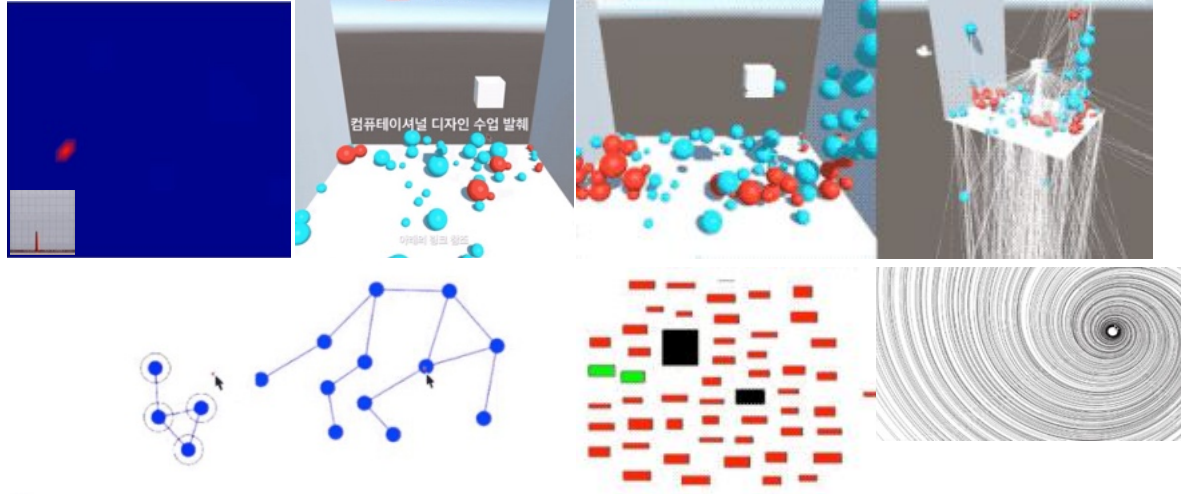
AI / ML / LLM / Generative model

BIM / BAM



Connectivity:

Dependency & Hierarchy & Relationship [link](#)

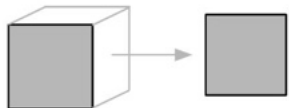


COMPUTATIONAL THINKING [link](#)

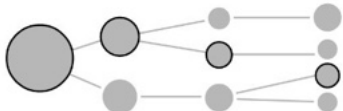
Problem solving & From implicit to explicit - 서문실명 <https://brunch.co.kr/@ninamju/1>

- 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 재사용성(reusable)
- 1.4. 수 체계 -
- 1.5. 프로그래밍 패러다임 ([Programminn paradigm](#))
- 1.6. 전공 영역(Domain)

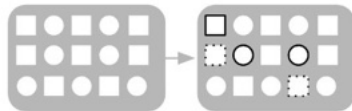
COMPUTATIONAL THINKING



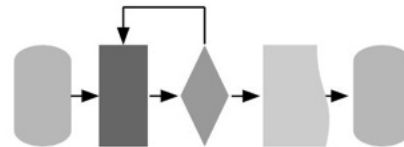
Abstraction



Decomposition



Pattern Recognition

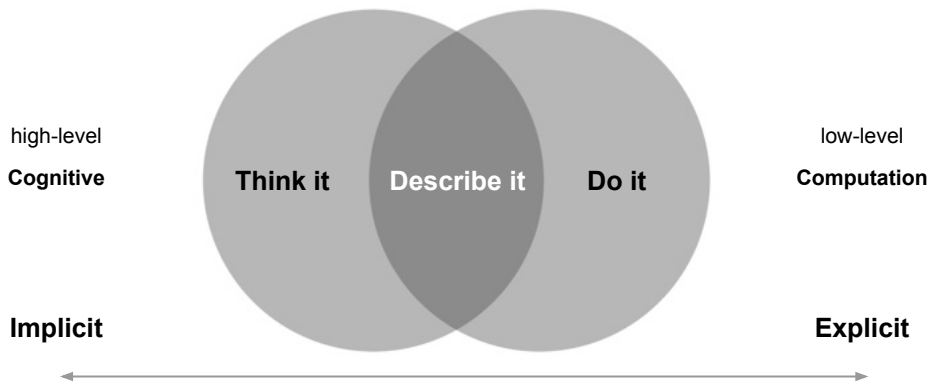


Algorithms

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

- QnA 102 컴퓨터이셔널 디자인 프로젝트 피드백 & 컴퓨터이셔널 디자인 사고 - [link](#)
- QnA 95 컴퓨터이셔널 사고 / 이론방식 접근 방식 / 문제 해결 방법 - [link](#)
- QnA 94 컴퓨팅모피스이유, 제품 디자인 학부생과 대화 그리고 컴퓨터이셔널 디자인 - [link](#)
- QnA 93 컴퓨팅모피스이유 - 데이터, 알고리즘, 학습방법, 기술과 디자인을 풀 때 - [link](#)
- QnA 85 건축학부2 컴퓨터이셔널디자인예제한3가지장문 - [link](#)
- QnA 84 건축학과2학년의장문, 컴퓨터이셔널디자인어떻게, 이해하고, 공부하고, 적용할까? - [link](#)
- SA 7.0 Lecture 2: 디자이너를 위한 컴퓨터이셔널 사고 / Computational Thinking For Designer - [link](#)
- [\[컴퓨터이셔널디자인\] 48 쪽은 내용과 방향 \(디자이너를 위한 컴퓨터이셔널 디자인 특강 2021\)](#) - [link](#)
- QnA 61 #컴퓨터이셔널디자인교육, 코딩 교육, 누가 가르쳐야 하나 - [link](#)
- QnA 59, 가장 일반적인 오해, 컴퓨터이셔널 디자인 이해를 - [link](#)
- QnA 56, 건축 컴퓨터이셔널 디자인 활용?, 응용방법?, 일련의 사고방식? - [link](#)
- ...
- 이거 [QnA 33번](#)에 가서() 'CM' + 'F'를 활용해서 키워드도 검색하시면 더 많은 자료를 찾을 수 있어요!

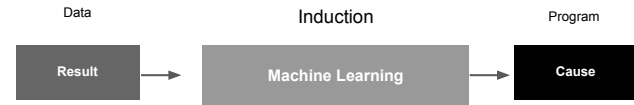
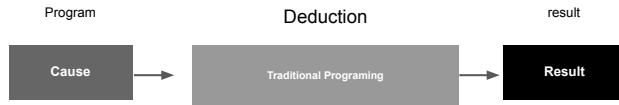
Design & Computation



from **function** to **result**

VS

from **result** to **function**



Traditional Programming, Software 1.0 [link](#)

Machine Learning, Software 2.0 [link](#)

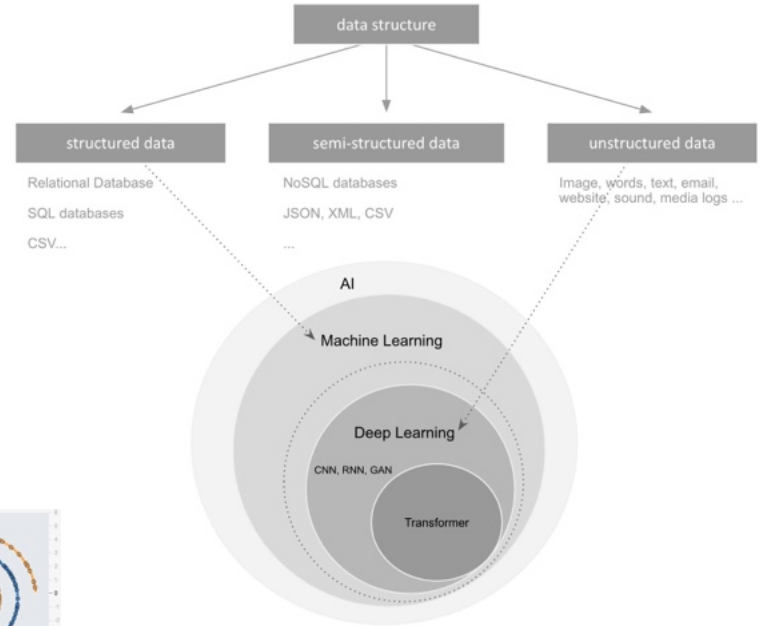
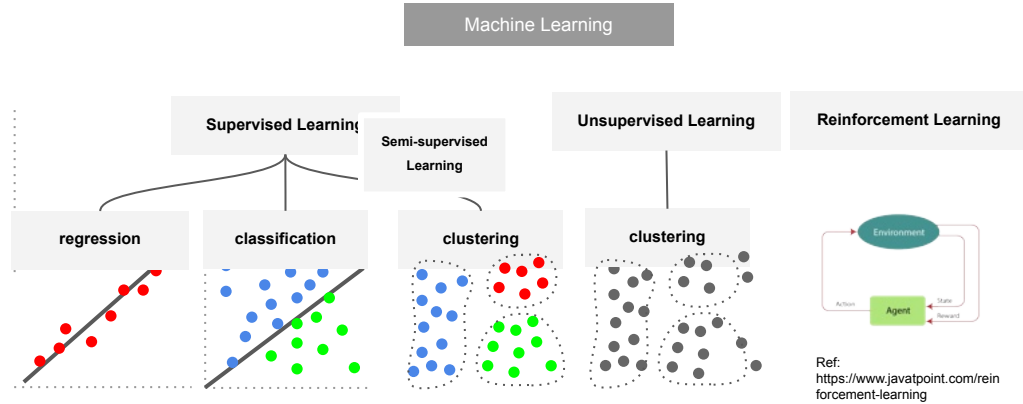
$$3 + 3 = ?$$

$$3 ? 3 = 6$$

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.

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

Methodology

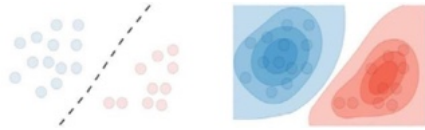
Statistical models; Machine learning algorithms, and data analytics techniques

Methodology

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

Machine Learning

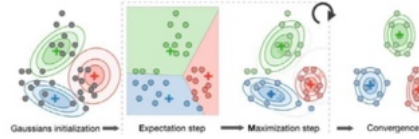
Supervised Learning



Discriminative model
Decision Boundary
Regressions, SVMs

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

Unsupervised Learning

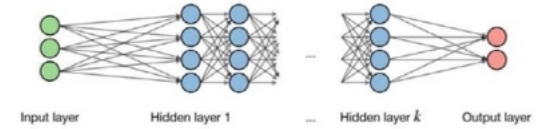


Clustering:
K-means clustering, Hierarchical clustering

Dimension reduction:
PCA (Principal Component Analysis), ICA (Independent component analysis)

Nonlinear dimensionality reduction:
t-SNE (t-distributed stochastic neighbor embedding)

Deep Learning

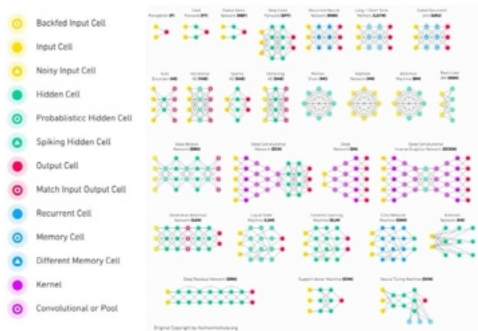


architecture

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

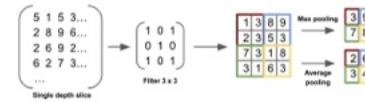
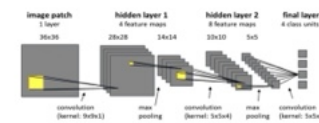
Reference: CS229 - Machine Learning, Stanford University

Neural networks basic architectures



© 2014 Georgia Institute of Technology

Convolutional Neural Network



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

Activation function

Reference:

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

Codification of the design process

Computational Design Thinking

Writing, Medium - <https://mjnamiu.medium.com/computational-design-thinking-for-designers-68224b0775c>

Lecture Video - <https://youtu.be/loGSrYoFm8>

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

디자이너를 위한 컴퓨테이셔널 토크링 / 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 - 과정에서 전략은? Manifesto / Policy
 - 09:30 - 결정론? 확률론? Deterministic / Stochastic
 - 10:00 - 확장할 것 인가? 집중할 것 인가? Converge / Diverge
 - 13:49 - Top-down / Button-up & Holistic / Partial
 - 14:21 - 존재하는 솔루션? 찾아 내야 하나? Existing / Emerging
 - 15:32 - 무엇을 향해서? 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 것 인가 - from Entangled to Separated
 - 24:17 - 현상에서 모델로 - Phenomenological(Observation) to Predictable(Model & System)
-
- 25:26 - 이행시 필요한 개념 / Implementation
 - 27:30 - 클래스의 장점 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 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 MANIFESTO & POLICY

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

...

THE IMPLEMENTATION

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

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)

...

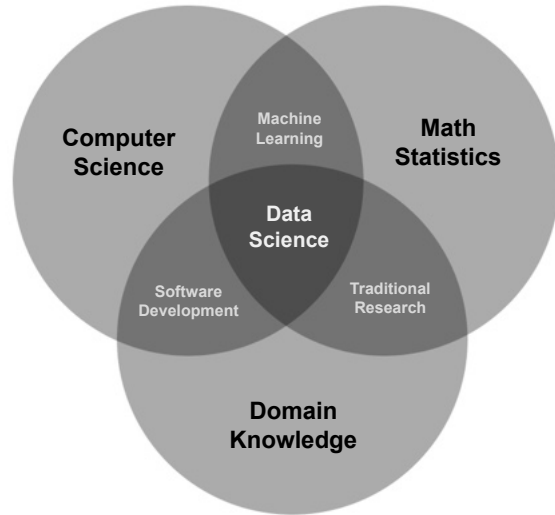
THE TOOL & THE PRINCIPAL

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

...

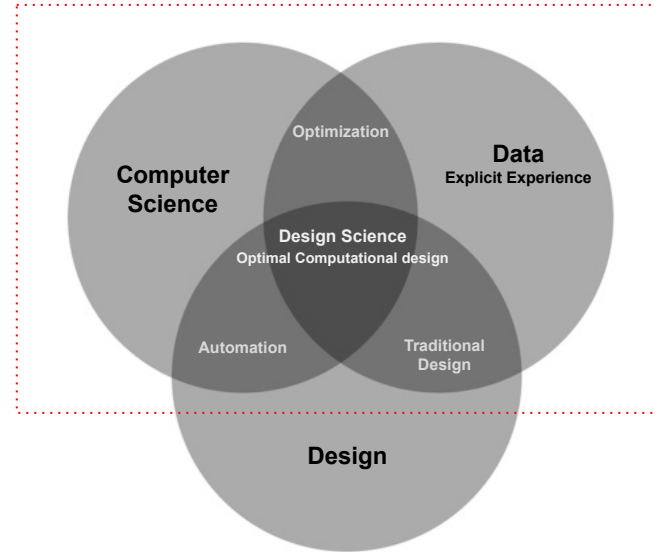
- 1. Differentiating Issues, Problems, and Tasks
- 2. Developing Spatial Data Structures
- 3. Deploying Algorithms

DATA SCIENCE



Computational XXX
Data Engineering
Data Science
...

DESIGN SCIENCE



Computational Design
Design Engineering
Design Science
...

Data & Design, Computational Design

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-namju.medium.com/data-design-c21457dc8dc>

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

Code for design

Codification of design process (decision makings)

디자인 프로세스의 코드화

DESIGN & DATA [link](#)

selected researches and projects

URBAN ANALYSIS & AI, ML

01. Third Place Mobility Energy Consumption Per Person

Date : 2016

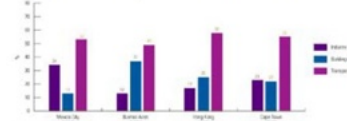
Type : independent project, Changing Places Group, MIT Media Lab
Prof. Kent Larson

Role taken : **independent project (director and developer)**

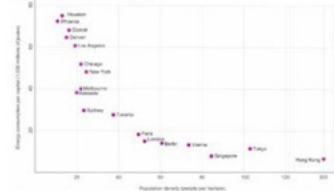
[Website](#) [Video Link](#) [Tool Link](#)

BACKGROUND

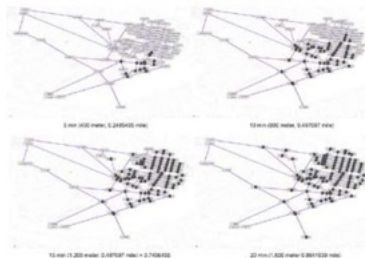
Energy is very essential resource in modern societies. Every major city in the earth consumes diverse type of energy such as fossil fuel, electrical energy, and etc at the expense of our environment. Climate change has become more important issue on modern society. However, everyday life, we need certain amount of energy to guarantee our live. Among the major energy consumption in cities, transform is major issue and it could be reduced.



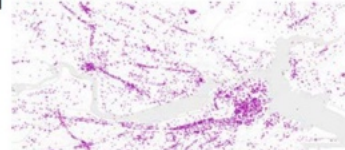
Urban population is a larger than rural areas, are concentrated on a area to deal with in term of urban mobility.



In this project, mobility energy is considered as numerical data in urban context and compute them to find better way of understanding transformation. Based on walkable distance, the data in the graph are computed.



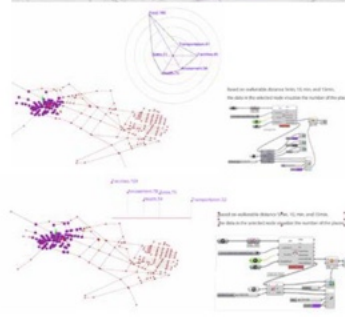
Data from Google Place



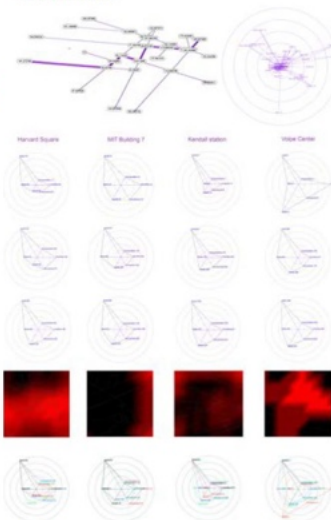
Type of query

parking, veterinary_care, airport, plumber, roofing_contractor, atm, meat_takeaway, hair_care, insurance_agency, bedshop, synagogues, stadium, movie_theater, doctor, zoo, electronics, rehabilitation, funeral_home, spa, aquarium, storage, casino, park, courthouse, hospital, subway_station, painter, moving_company, movie_rental, umbrella, fire_station, gym, bicycle_store, local_government_office, book_store, police, florist, museum, lawyer, law_firm, real_estate_agency, physiotherapist, electronics_store, Hindu_temple, car_dealer, jewelry_store, gas_station, mosque, liquor_store, bar/ground, library, university, accounting, travel_agency, travel, bookstore, bank, convenience_store, health, church, bakery, lodging, laundry, shopping_mall, dentist, store, cemetery

Graph data structure



Sites and results



summary

Mobility Energy Consumption

Basically, as to Mobility Energy Consumption in urban, it could be measured by computing Third place. In this research, the assumption is that 5 min, 10 min to 10 min walkable place could be considered as an identical area so that it can be characterized and visualized as a radar plot.

Data manipulation

Google Place is harnessed as key data for Third place in the areas, and Graph structure is utilized for data manipulation. Node in the Graph has its own Google Place data within distance, and Edge is for computing distance in the urban network of the city.

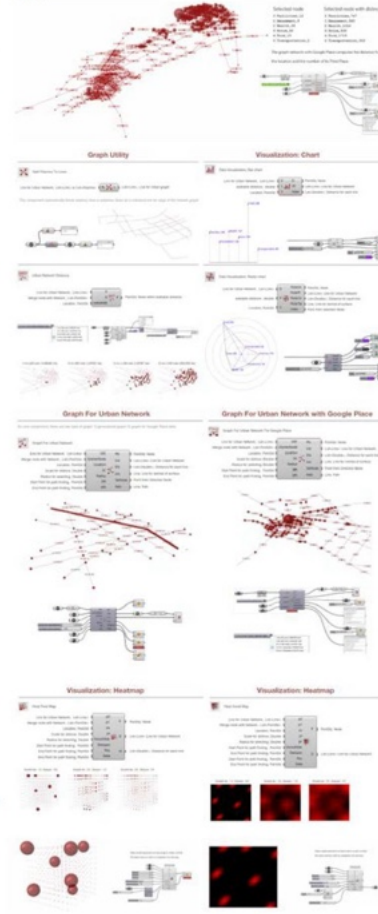
Data visualization

For Harvard Squares, high density is shown compared to other places for example there are 110 food places in 5-min walkable areas. For Volspe Center, the number of food place start from 6 places. However, it is rapidly increased due to the Cambridge Side Galleria.

Conclusion

This research reveals the Mobility Energy Consumption for Third place. Thus, it allows designer to improve the Mobility Energy by remove or add the place categorized into 1: Facilities, 2: Amusement, 3: Health, 4: Store, 5: Transportation.

Tools



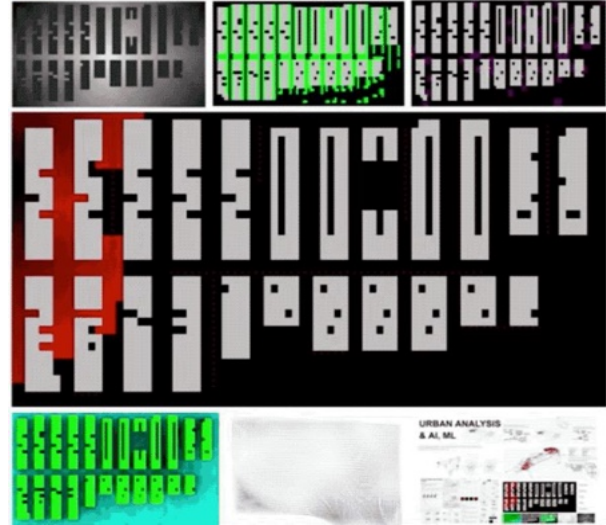
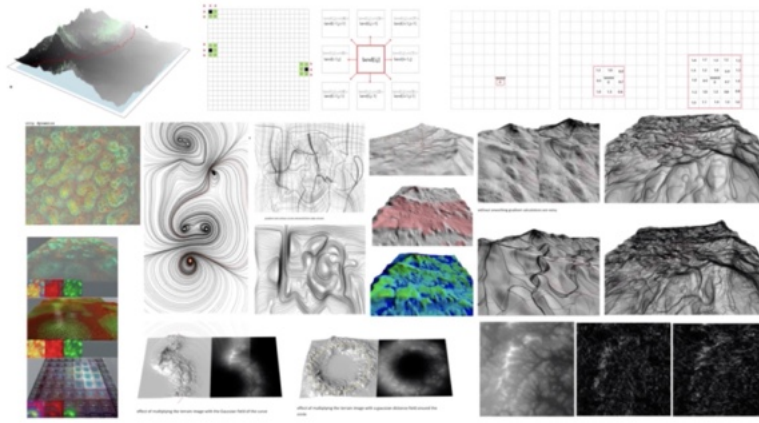
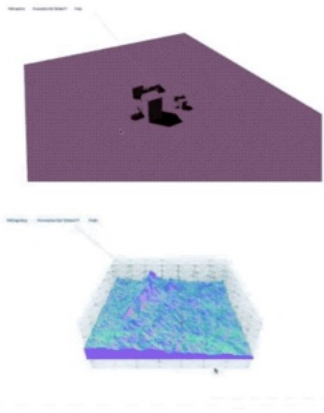
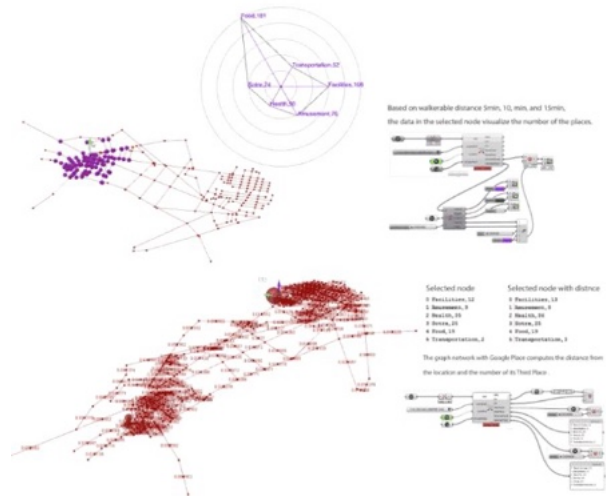
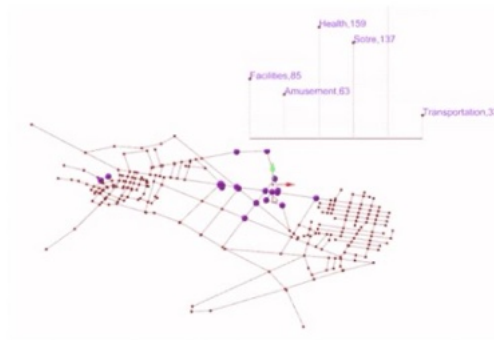
<https://namulee.github.io/njs-lab-public/project/2016-mobility-energy-consumption-mit-media-lab/>

Addon for Grasshopper
<https://www.food4rhino.com/app/numerical-urban-utility>

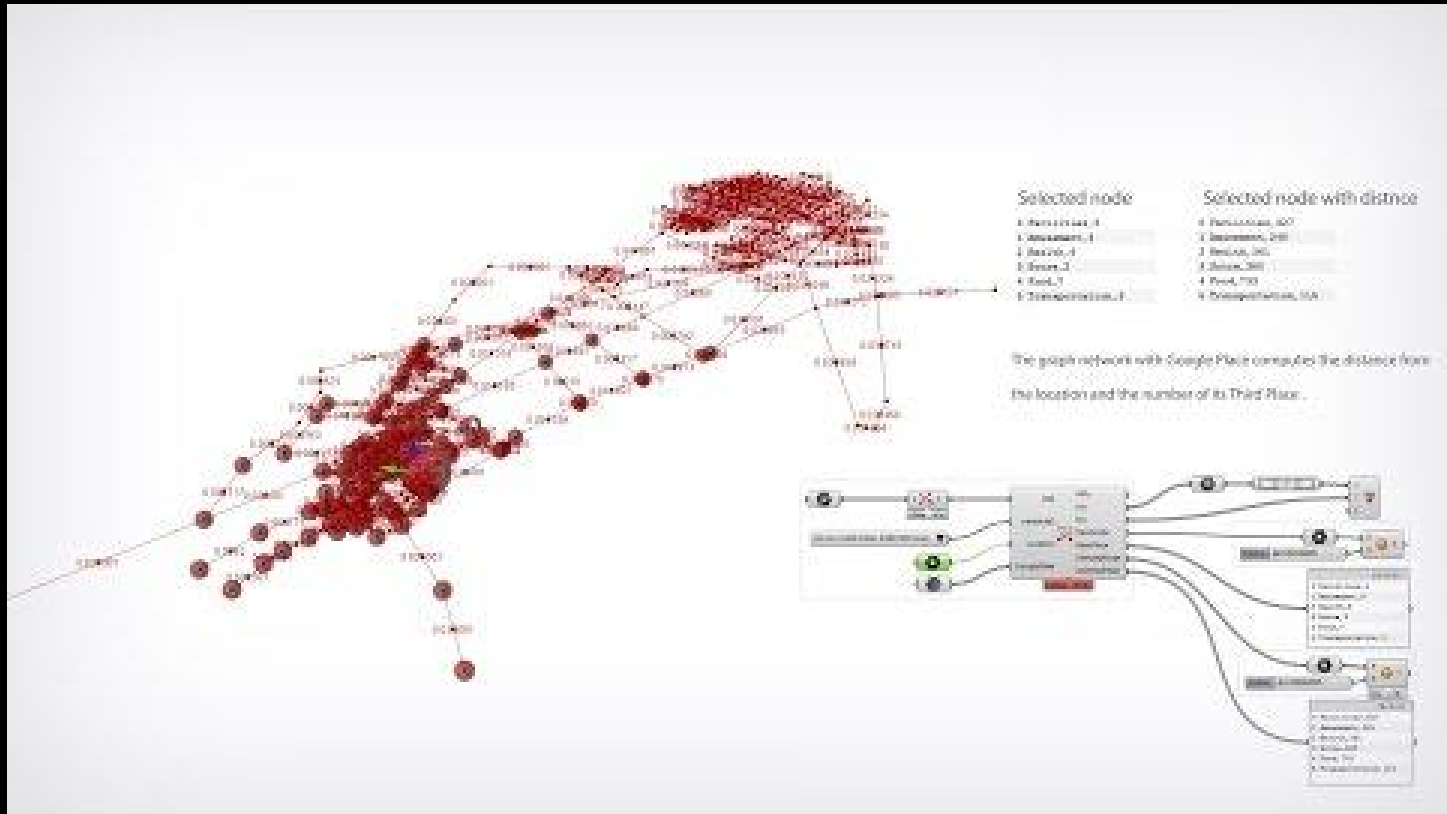
Paper: <https://www.springer.com/gp/book/9789813343993>
https://link.springer.com/chapter/10.1007/978-981-33-4400-6_11



URBAN ANALYSIS & AI, ML



Properties
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park)
outd
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Comfort
view



Third Place Prediction model, Boston, LA, Redlands

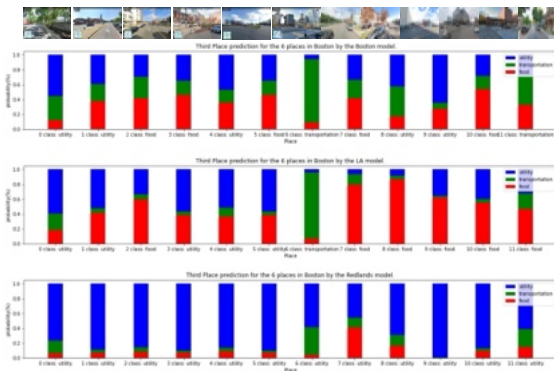
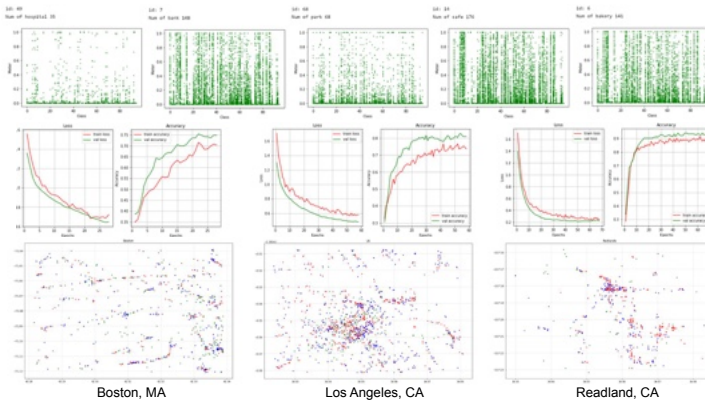
Data process, Model A, Model B, Implementation

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

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

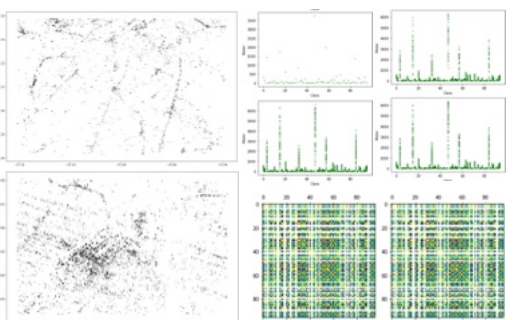
Source code: <https://lnkd.in/qdf6d8j7>

Lecture: <https://namu.wiki/w/Data-Driven-AI-for-Urban-Data-and-Viz/Howver-GSSD-2023>

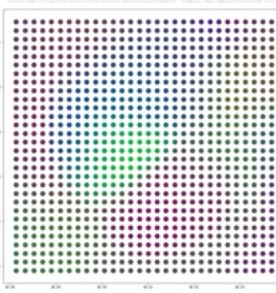
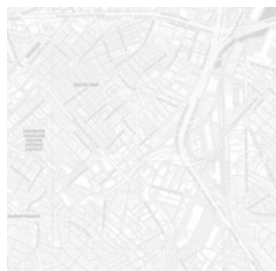


95 Class

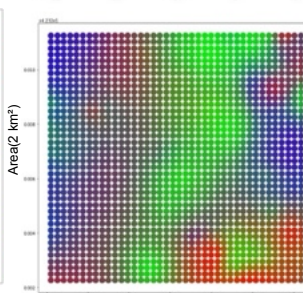
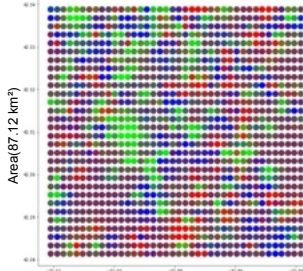
["convenience_store", "amusement_park", "aquarium", "art_gallery", "bar", "bakery", "bank", "bar", "beauty_store", "beverage_store", "book_store", "bowling_alley", "bus_station", "cable_car", "campground", "car_rental", "car_wash", "car_dealer", "car_repair", "casino", "cemetery", "cinema", "city_hall", "club", "coffee_shop", "community_center", "conference_center", "convenience_store", "courthouse", "department_store", "dentist", "diner", "disc_golf_course", "dry_cleaning", "electronics_store", "embassy", "entertainment_center", "fire_station", "florist", "food", "funeral_home", "furniture_store", "gas_station", "golf_course", "golf_range", "grocery_or_supermarket", "hair_care", "hardware_store", "health_beauty", "hobby", "home_goods_store", "hospital", "house_of_worship", "ice_cream_maker", "jewelry_store", "kitchen_appliance_store", "laundry", "lawyer", "liquor_store", "local_government_office", "locksmith", "lodging", "meal_delivery", "meal_preparation", "medical_supply", "miscellaneous_store", "movie_theater", "music_store", "newsstand", "night_club", "paint_store", "park", "parking", "pet_store", "pet_supplies_store", "pharmacy", "physical_therapy", "place_of_worship", "plumber", "post_office", "real_estate_agency", "restaurant", "roofing_contractor", "rv_park", "school", "shoe_store", "shopping_mall", "spa", "stadium", "storage", "store", "subway_station", "synagogue", "taxi_stand", "taco_stand", "travel_agency", "university", "veterinary_care", "zoo"]



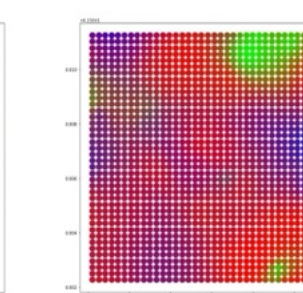
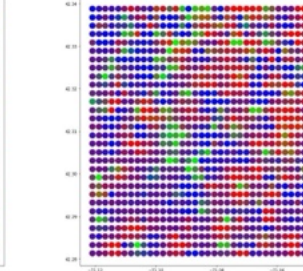
Third Place prediction results in Boston



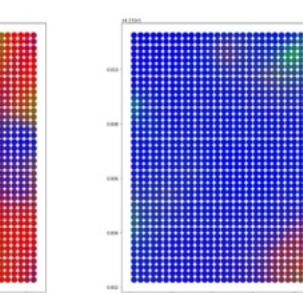
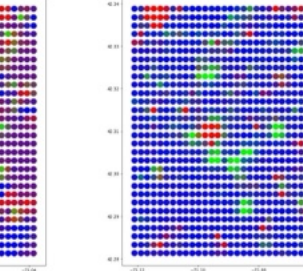
● Food ● Transportation ● Utility



Boston, MA



Los Angeles, CA



Readland, CA

02. Built Environment Assessment for the Housing Value Prediction

Date : 2016 Fall
 Type : CS 109 Data Science, John A. Paulson School of Engineering and Applied Sciences, Harvard University

Role taken : research, design, drawing, modeling, visualization
 Coder : Phil, Pawlos Protopapas, Kevin Rader, Weesun Pan
 Tutor : Jia Gu, Eille Jungmin Han

http://www.nistudio.com/kr/main/project/2016_Harvard/CS109_DataScience/index.html

Is there any relationship between Built environment and rent prices?

This question motivates us to investigate to enrage the relationship between social economic aspect (housing and rent price data) and urban spatial data (built environment data) in City of Boston.

Methodology

We define city infrastructural data such as the current housing price, energy consumption of the area, income of neighborhoods, transportation accessibility, green space in the neighborhoods, specific housing features, and crime rates as "top-down data." We also define informal crowdsourcing data such as, twitter texts, Instagram tags, or Yelp reviews as "bottom up data." There is a third category of data that has not been widely deployed yet which we define as the "holistic visual data." It is the general impression to your visual surroundings when you at a specific spot that we believe can be captured by Google street view.

By testing on the data of visual surroundings as dependent variables, we hope to capture missing information from the top down data and therefore tell if the visual environment is a significant feature in a housing prediction analytical model. We use machine learning methodology to pre-process Google street views to give certain attributes. To combine different data sets from top-down to bottom-up into one file for machine learning, we use graph data structure. Basically, we collect information on different locations and merge them together in specific pixelized grid based data points utilizing graph structure.

Step 1 : Data Parsing

Parsing, cleaning, and data structure

Step 2 : Data Exploration

Data Visualization and Exploration

Step 3 : Learning Housing Price

Lasso, ridge, RandomForest Regression, and ETC

Step 4 : Learning Renting Price

L1/L2, Lasso, ridge, RandomForest Regressor, PCA for Logistic Regression, Decision Tree, Random Forest Classifier, and ETC

Step 5 : Conclusion

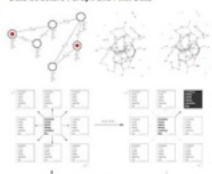
the conclusion of the research



Housing Price data from Zillow
 number of data used: 988 houses

Rent Price data from Trulia
 number of data used: 13049 rents

Data Structure : Graph and Pixel Data



SOCIAL ECONOMIC DATA

Renting Prices Data From Trulia
 data type : numeric and category
 features: zip code and bedroom, sq. address, date, rent price, SQ Footage (sqFoot)

Housing Prices Data From Zillow
 data type : numeric and category
 features: zip code and bedroom, sq. address, number of bedrooms and bedrooms, estimate amount, price, property size, sq. lot size, street, address, full rent date, last sold, year built, home type, home type, property

Energy data in Boston from Boston Data
 data type : numeric and category
 features: data ID, geographic coordinate, Sq. Footage, Water Flow, Gas Usage, Oil Storage, Energy Use, City, Address, ZIP, District, Property Type, District, Address, GHG Intensity, Year Built, Property Type, Water Use

Crime data in Boston from Boston Data
 data type : numeric, string, and category
 features: year, case, crime, geographic coordinate

Properties Assessment in Boston from Boston Craigslist
 data type : numeric, string, and category
 features: merge land value, geographic coordinate

House and Room post data in Boston from Boston Craigslist
 data type : numeric, string, and category
 features: date, size of area, content of text, geographic coordinate

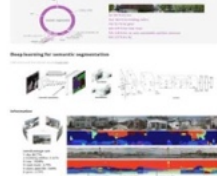
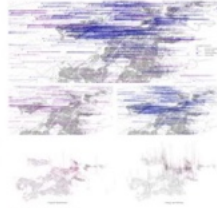
URBAN SPATIAL DATA
google place from Google place API
 data type : numeric, string, and category
 features: geographic coordinate, type of place, placetext, food, MSA, etc.

google street view from Google street API
 data type : numeric, string, and category
 features: RGB values and mathematical numerical features



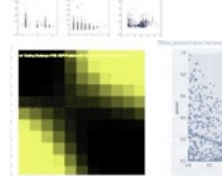
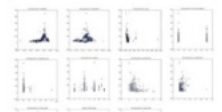
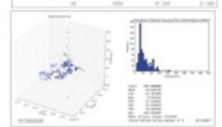
2. Data Exploration

On top of the top-down data (generated by the local government), the bottom-up data (post processing of Google Street Views, Google Places, and Craigslist Boston), and the top-down data (Crime data from Data Boston and housing price data from Zillow.) can be mapped and deployed for train and continue the analytical model of predicting housing prices. To process the google street view data, there are two data structures (pixel and graph data structure) where individual data are populated and calculated. Pixel data structure is a matrix, discretizing an urban or district into a finite setting for analysis, in which each pixel has the relationship with its neighbors, and each one computes its own data on the basis of neighbors' settings, so that urban data can be naturally addressed and computed in spatial context.

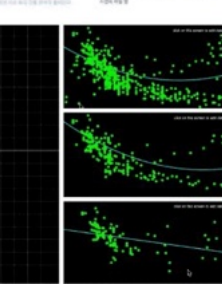
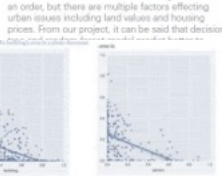
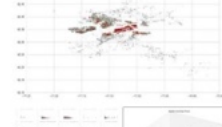
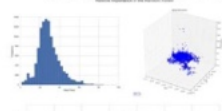
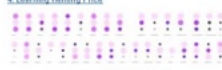


3. Learning Housing Price

We explored housing prices statistics and the relationship between Boston housing price and our dataset features. Boston's average housing price is around \$669k and the median is about \$609k while it has a range from \$3.4k to \$4.47M2, which ranks quite high nationally. According to Zillow home values report, the national average housing price is \$13.2M2. (<http://www.zillow.com/home-values/>)

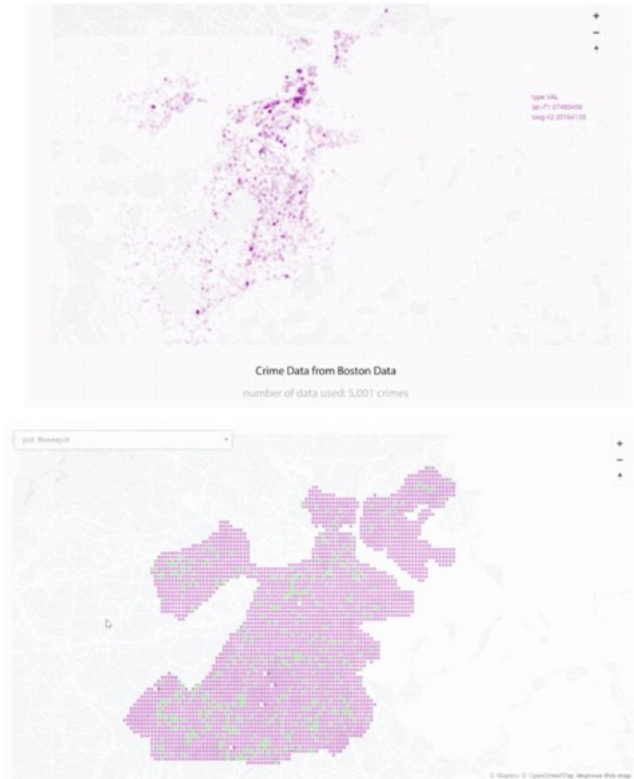


4. Learning Renting Price



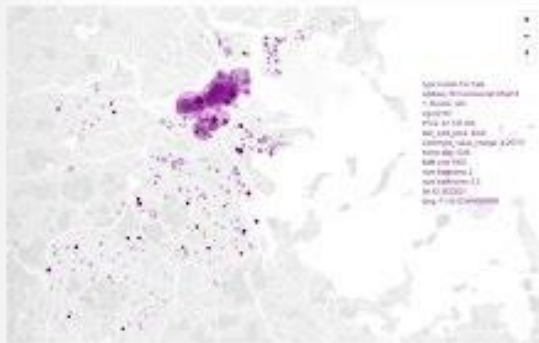
5. Conclusion

Integrating urban matrix needs to be organized such an order, but there are multiple factors affecting urban issues including land values and housing prices. From our project, it can be said that decision



Data from Google street view + Deep Learning for semantic segmentation

Image data used: 18,588 images



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

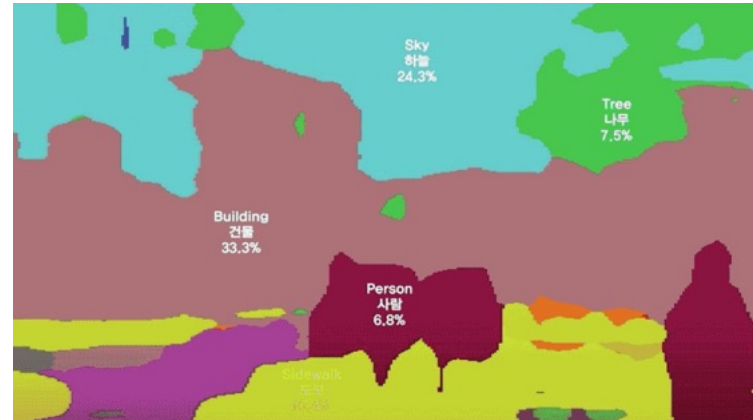
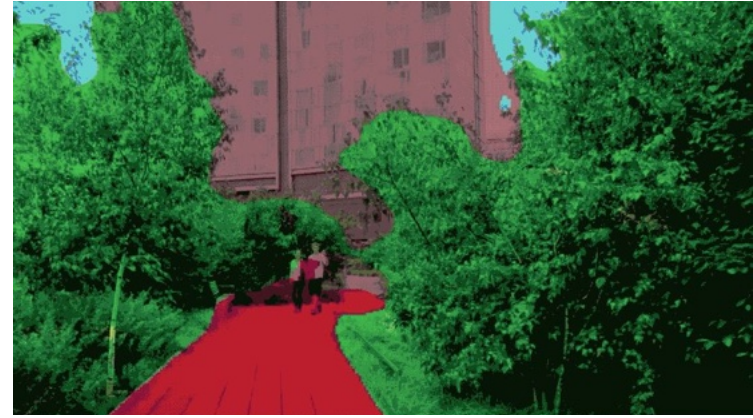
This project examines how the changing urban environment is perceived by the public and how they are represented through new emerging technologies. I developed a design pipeline for the project that enabled analyzing and visualizing big-data available to the public.

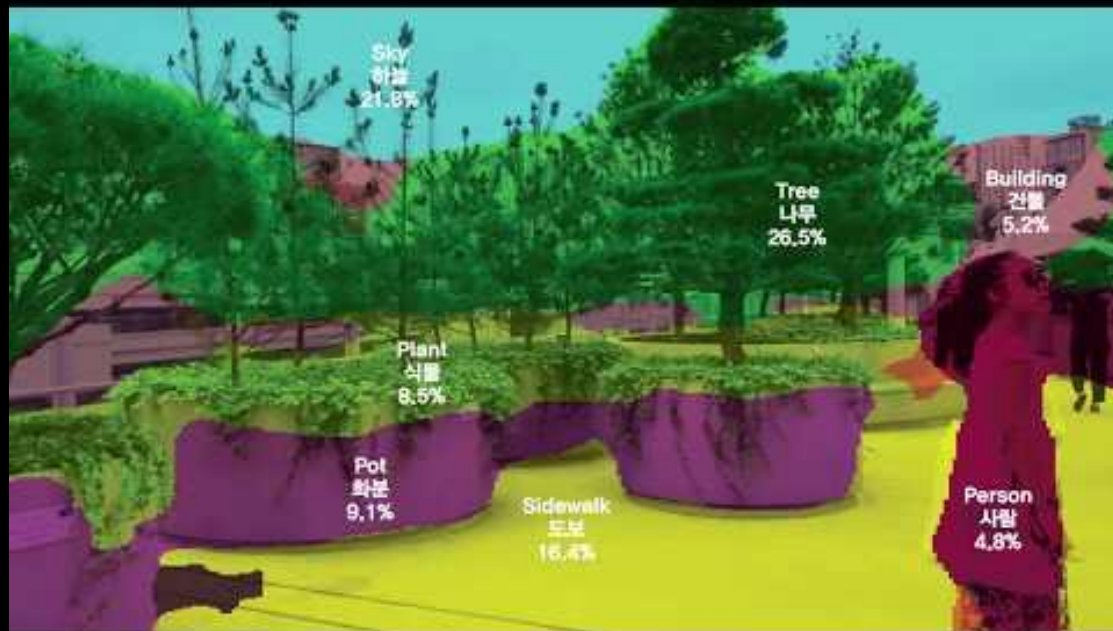
There are an enormous amount of big data being produced by the public, images posted on Instagram is such example. In parallel, there are emerging computational algorithms that process such big-data. However, the urban design discipline has not been able to meaningfully bridge the gap between these emerging 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 people upload on the web in the site. By using Deep Learning, I analyzed the 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 the 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 Zaera-Polo.

Link:

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





Link: <https://namiulee.github.io/nis-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-niu-dev-eflooment>

**NUMERICAL IMAGE UTILITY
AN ADDON FOR GRASSHOPPER IMAGE PROCESSING**

Date: 2018 - present
Type: independent project
Role: creator, project director and developer
Website: <https://namjulee.github.io/njs-lab-public/work?id=2018-niu-dev-eflooment>

The screenshot displays a complex Grasshopper workflow for image processing. It includes several input images, processing nodes, and output visualizations. Key outputs include:

- A grid of color-coded images showing different processing stages.
- A 3D visualization of a terrain map with a color gradient from blue to red.
- A 3D visualization of a point cloud or mesh structure.
- A 3D visualization of a textured surface.

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

This screenshot shows the application of the Numerical Image Utility to a white rabbit image. The workflow includes:

- Input image of a white rabbit.
- Processing steps for color and grayscale conversion.
- Output visualizations showing the rabbit in various color schemes (e.g., red, blue, green).
- 3D visualizations of the rabbit's shape, including a point cloud and a textured mesh.

AERIAL SEMANTIC SEGMENTATION

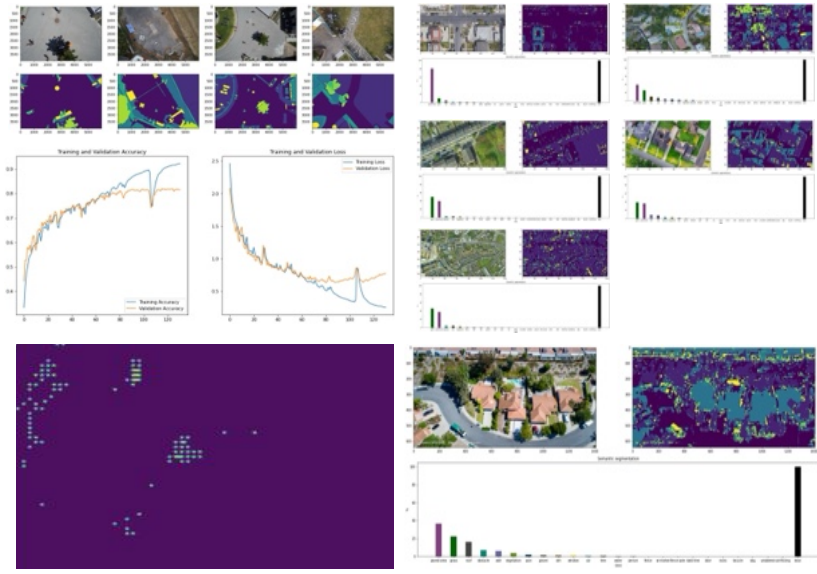
Machine Learning & Implementation

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

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

Classes

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



SMTracer

Sketch to Map Translator

ESRI Storymaps Hackathon

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

LANGUAGE

Python
Typescript

PROCESS

1. Data Collections and Preprocessing:
2. Trains and Validations for each model:
3. Design, Visualization and Video:
4. Development for Sketch App:

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)

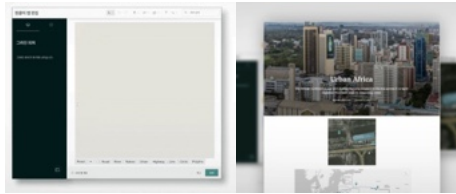
Sketch-to-Map Translator



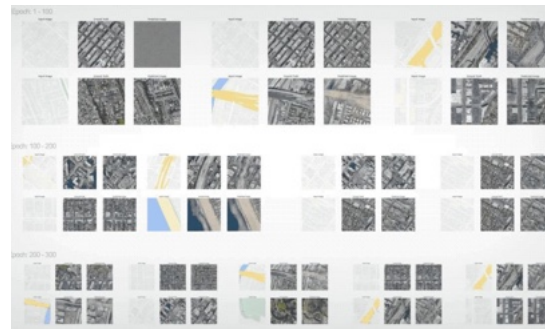
Data collection and preprocessing



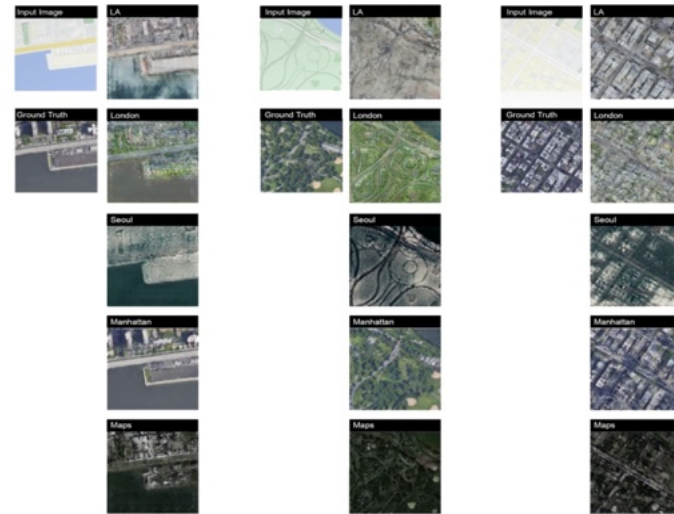
Sketch App



Training and Predictions



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



Generated maps by the machine



Generated map by the smart tracer



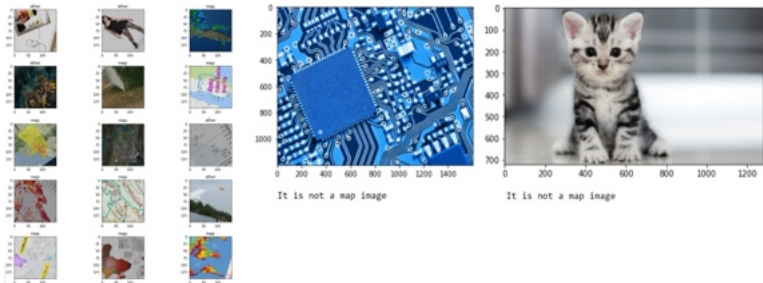
Map Classifier

Machine Learning & Implementation

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

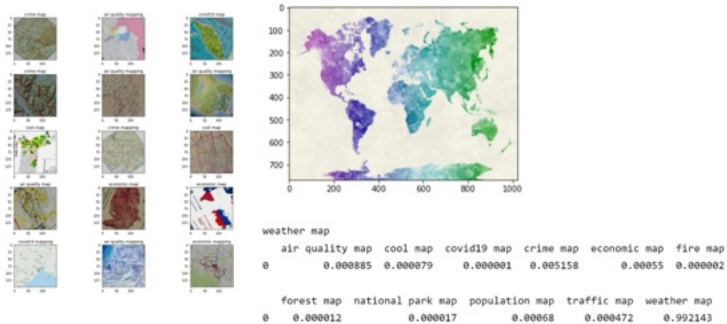
Classes

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]

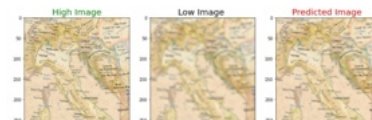
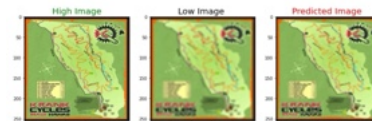
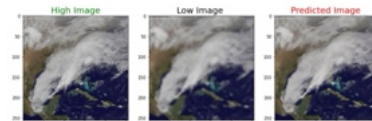
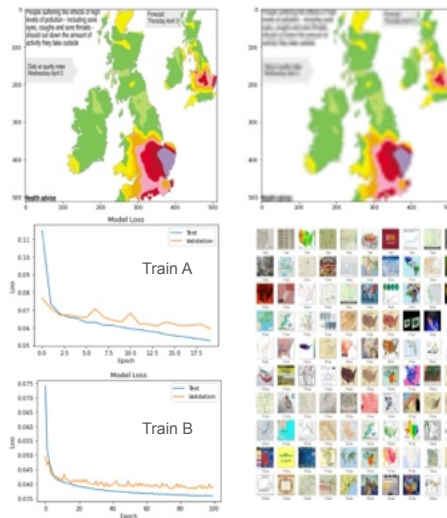


Map Super Sampling

Machine Learning & Implementation

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

Train data : 3,000 (maps)

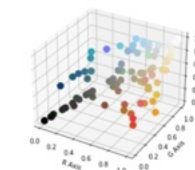
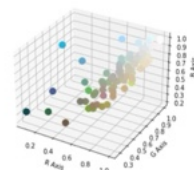
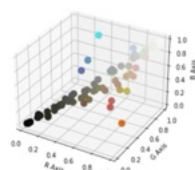
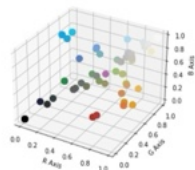


0 air quality map

7 crime mapping

15 national park mapping

17 population mapping

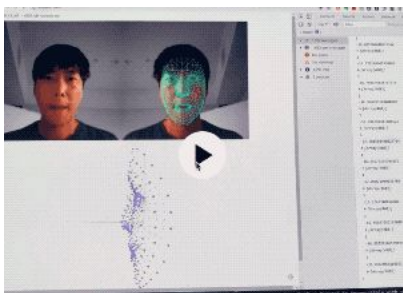


THE COLOR AI

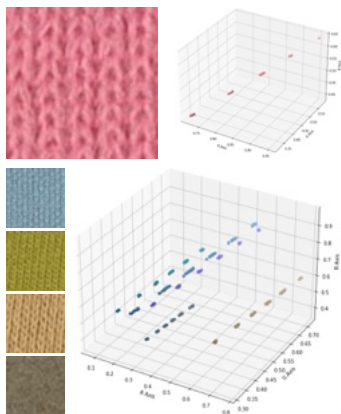
Machine Learning & Implementation

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

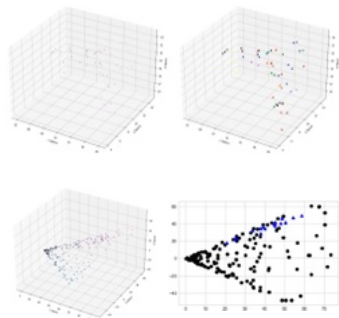
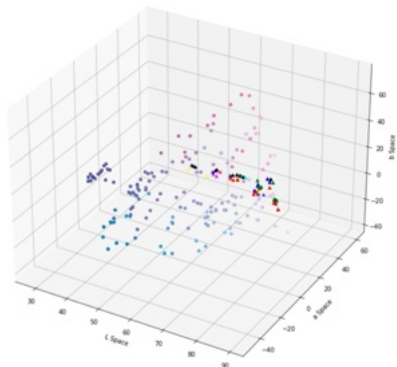
Personal Color & prediction and implementation



Texture detection



Demo

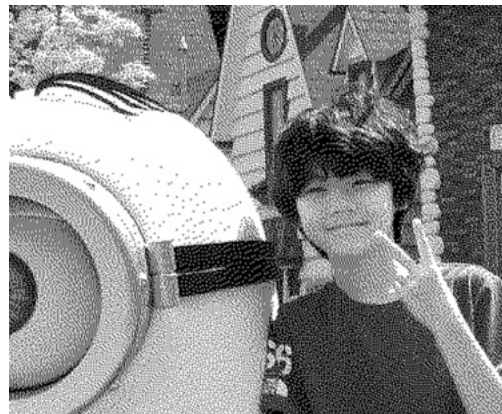


REST API and Image Processing

Machine Learning & Implementation

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

Demo



Demo



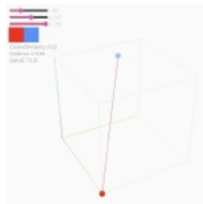
Color Correction - hue / contrast / saturation / invert / image filter



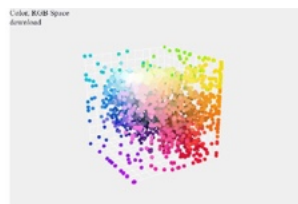
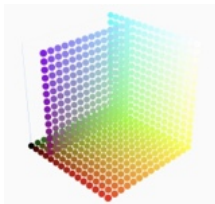
Demo

COLOR DATA

colors spaces

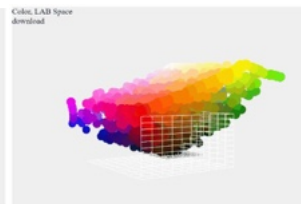


[Color Difference](#)



```
name="color"
key="rgb"
xyz=192
xyz=225
xyz=252
xyz=279
xyz=306
xyz=333
xyz=360
xyz=387
xyz=414
xyz=441
xyz=468
xyz=495
xyz=522
xyz=549
xyz=576
xyz=603
xyz=630
xyz=657
xyz=684
xyz=711
xyz=738
xyz=765
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xyz=846
xyz=873
xyz=900
xyz=927
xyz=954
xyz=981
xyz=1008
```

[Color Space](#)

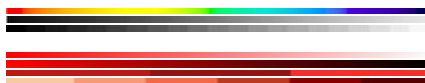


```
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xyz=192
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xyz=954
xyz=981
xyz=1008
```



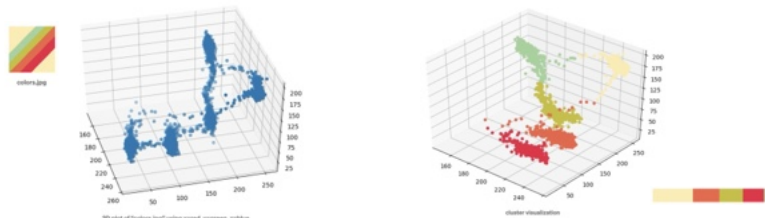
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xyz=684
xyz=711
xyz=738
xyz=765
xyz=792
xyz=819
xyz=846
xyz=873
xyz=900
xyz=927
xyz=954
xyz=981
xyz=1008
```

color as scales



https://matplotlib.org/3.1.0/mpl_toolkits/axes_helpers.html#color-to-distance

Dominant colors in an image using k-means clustering



Ref: <https://buzzrobot.com/dominant-colors-in-an-image-using-k-means-clustering-3c7a4622036>

NNA, NUMERIC NETWORK ANALYSIS TOOLBOX

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

Medium:
<https://nj-namju.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>

Lecture, NYIT
https://youtu.be/_9I7dp5o6A0

Accessibility Analysis
 Reach, Gravity, Huff-model

Centrality Analysis
 Betweenness, Closeness, Straightness, Degree

SITE ANALYSIS Betweenness

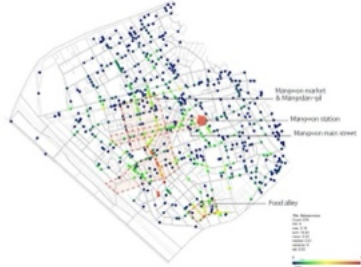
Definition of betweenness

$$Betweenness[k]^* = \sum_{i \neq k} \sum_{l \neq k} \frac{N_{d(i,j)}[k]}{N_{d(i,l)}} \frac{N_{d(j,l)}[k]}{N_{d(j,l)}}$$

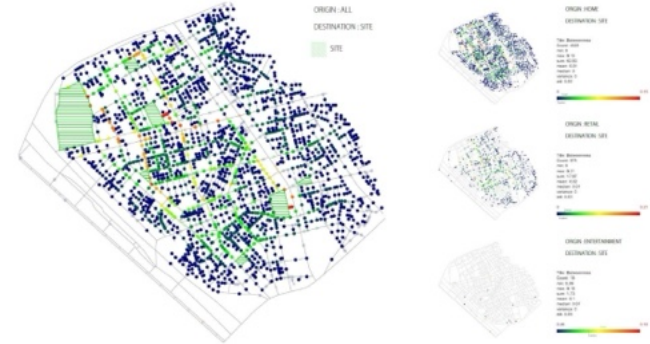
The Betweenness Index is the total number of shortest paths (N) at the target location (k) divided by the total number of shortest paths that exist between two nodes (i and j) of a given radius (r).

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

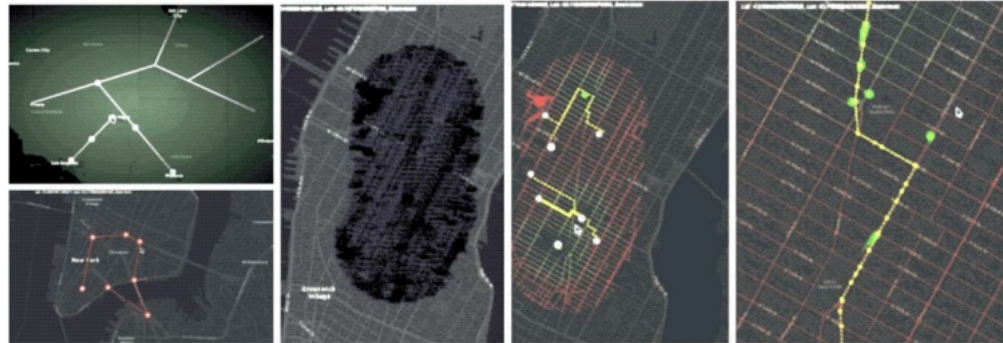
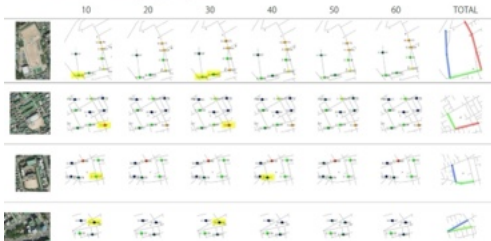
| Title | Betweenness |
|-------------|---------------|
| Origin | retail |
| Destination | entertainment |
| Count | 878 |
| Min | 0 |
| Max | 0.19 |
| Sum | 19.24 |
| Mean | 0.02 |
| Median | 0.01 |
| Variance | 0 |
| Std | 0.03 |



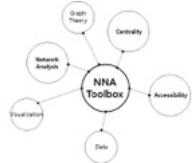
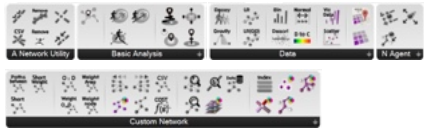
SITE CONTEXT betweenness - site



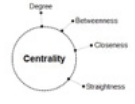
SITE SELECTION comparison using the age weight of NNA



Graphic User Interface for the GH implementation



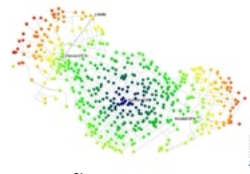
Degree
(No. connectivity at each node)



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.



Betweenness
(Home to MBTAs)



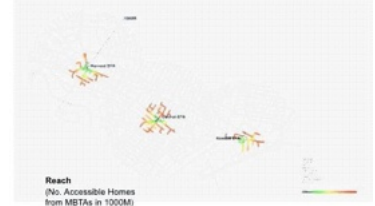
Closeness
(Home to MBTAs)



Straightness
(Home to MBTAs)



Huff
(Probability to visit locations)



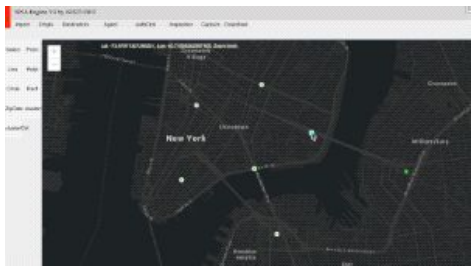
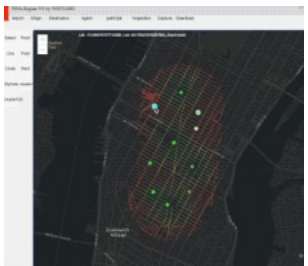
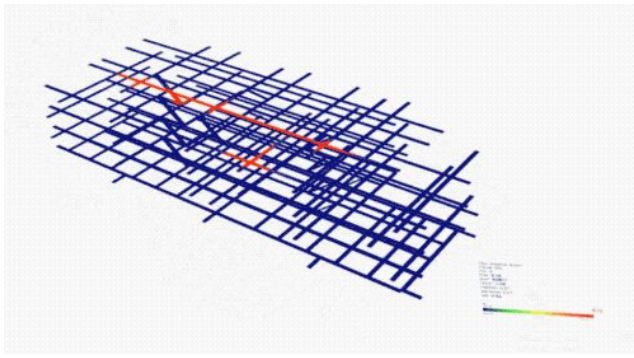
Reach
(No. Accessible Homes from MBTAs in 1000M)



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

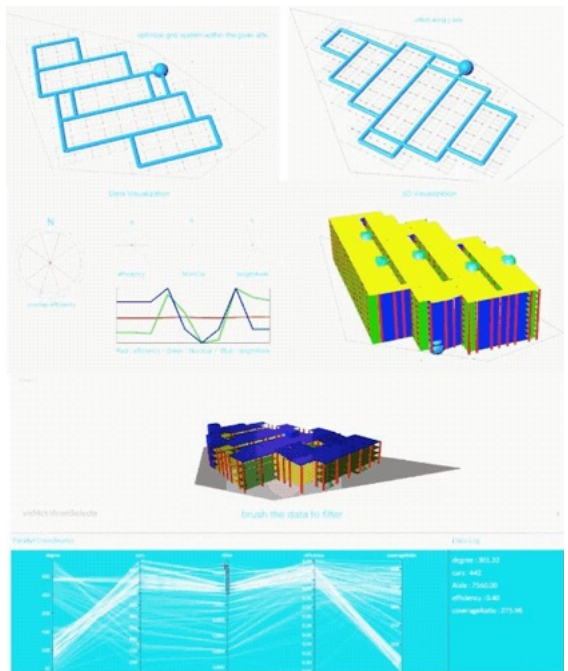
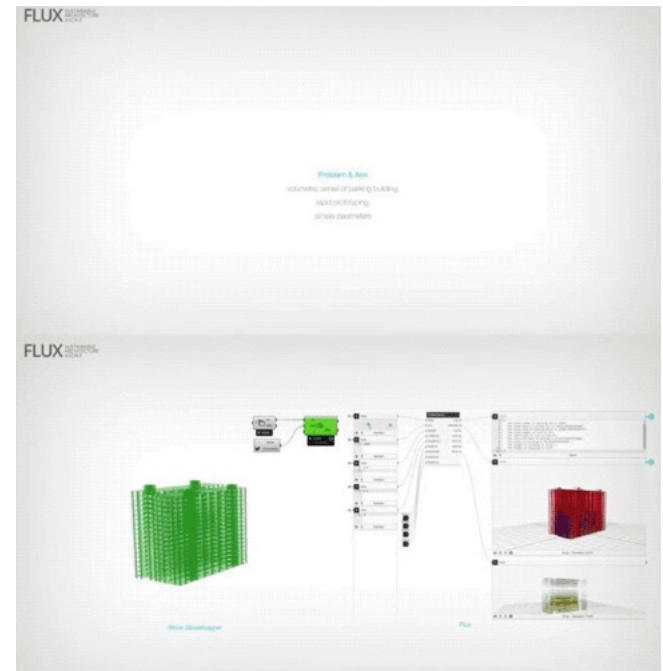


Accessibility analysis has been researched in the field of physical planning and spatial modeling for over 50 years. The concept of accessibility explains both **activity patterns in space** and the **connections between activities** linked to Newton's law of gravity. Hansen's "How Accessibility Shapes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



PARAMETRIC & OPTIMIZATION 2016

<https://namulee.github.io/nis-lab-public/work?id=2016-parke>
rator-flux-factory



PARKERATOR in Flux Factory (Data Driven Design)

Date: 2016
 position: Application Engineer Intern (Computational Design in Flux Factory)
 Scale: 1km: research, design, modeling, visualization
 Web Link: [Parkerator 1 Link](#) [Parkerator 2 Link](#)

Sub-optimized design system
 As a first step in Flux, I developed a multi-story car park (MCP) configurator for 3D in Singapore. Among other requests, the idea of a "Parkerator" (Shaping + Configuration) is a design strategy on Flux flow and developer to generate parking building. Each view of the most suitable projects for the implementation of computational design solution for the following reasons:
 (1) It should be fully automated process before decision making phase.
 (2) It should be model-based because the complex views present modules in the construction phases.
 (3) It should provide the maximum design variety possible for an existing site.

Singapore being one of the denser 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.



Objectives and problem:
 - Push-out the generated condition in the parking building.
 - Rapid prototyping for design response with the number of cars and the length of building.
 - Simple descriptive matrix about the building.

Parameters:
 - Number of Car
 - Number of floor

Color hierarchy in the 3d code
 - Building size
 - Auto: function related to create mesh and surface
 - Left: check for the status for building
 - Right: check for the status for building
 - Bottom: check for the status for building



Define Blue Print in the same boundary condition
 - Auto: function related to create mesh and surface
 - Left: check for the status for building
 - Right: check for the status for building
 - Bottom: check for the status for building



Define early point and back of the building
 - Auto: function related to create mesh and surface
 - Left: check for the status for building
 - Right: check for the status for building
 - Bottom: check for the status for building



Parameter Phase 2

The overall goal is to achieve 3 objectives:
 (1) How to search various site condition efficiently
 (2) How to design design strategy for a site and provide users with the data for their intuitive design
 (3) How to reuse and improve the algorithms from Parkerator Phase 1



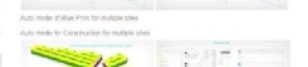
Grid Optimizer
 To achieve 1st objective, we continue a Grid Optimizer that stages a grid system in which cell can be manipulated in primary boundary condition. Basically, it creates a grid and varies from 1m to 100m degree to find a suitable grid within the red area, and find a best site and sub-optimize at the given site output. In addition, it also incorporates with a random mode to explore the design space finding individual set of parameters to fulfill the parameter. Then, using their optimal functionality to find the optimal parameter in the data for our problem.

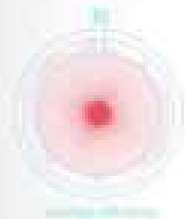
Data Refiner for design space
 It shows a small visualization which ranges site to color coordinate system to directly visualize data based on their own direction from 0 to 100 degree with the color from spectrum. For the design mode, the viewer had control over a single change of parameter and visualize a 2D graph and visualize graph for their design mode that more data visualization to give with the parameter.

Blue Print & Generator
 For 2nd goal, the design process is described as two parts: 1) Blue Print part: Construction part, the multiplier makes it more efficient and parametric in the more complex programming. In the Blue Print phase, the algorithm incorporates a mathematical comparison in their parameter data of a parking building as a blue print. In that period, the grid optimizer also helps. Since one mode was not blue print, the algorithm had to create a new mode and parameter and draw them on viewer based on the 2D. For the implementation for different platform, we need to simply rewrite a function handling the 2D with a few libraries like: React, Canvas, HTML, JavaScript, in the Construction phase.

Objectives and problem:
 - Change building layout based on an arbitrary site boundary condition
 - Provide a solution with grid
 - Manual mode for those who want to explore the design space
 - Different mode for those who want to find the optimal option in their mode

Parameter:
 - Site boundary condition (path)
 - Area (point/area/width)
 - Axis mode: Manual Mode with degree based (manual)

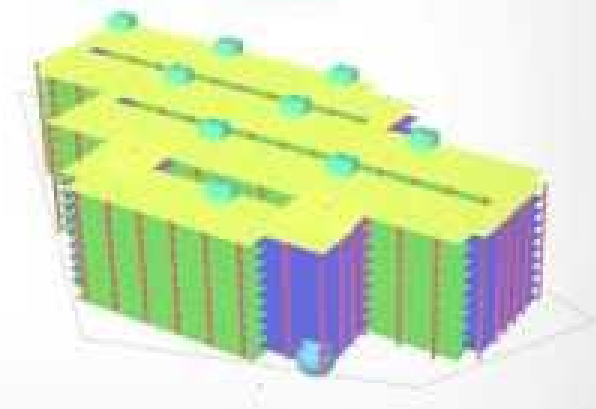




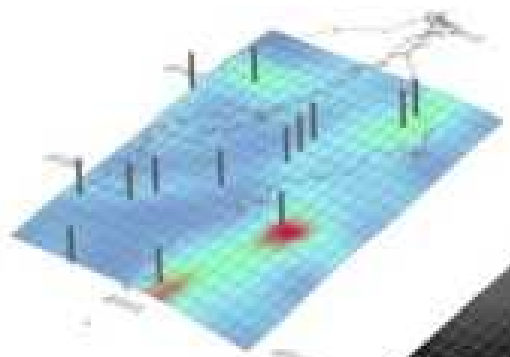
Time Visualization



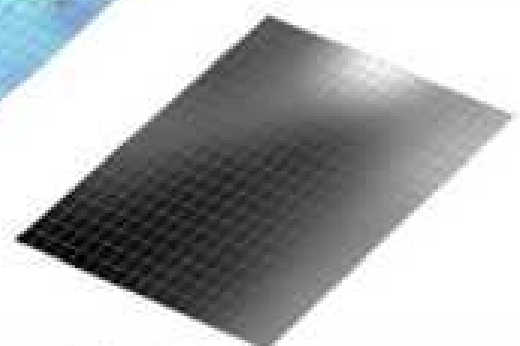
3D Visualization



SCENARIOS_UPDATED.MAT



different number of initial column



OCCUPANCY BY AGENT

DESIGN SYSTEM & AI, ML VOXEL REPRESENTATION

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

Short: <https://namijulee.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

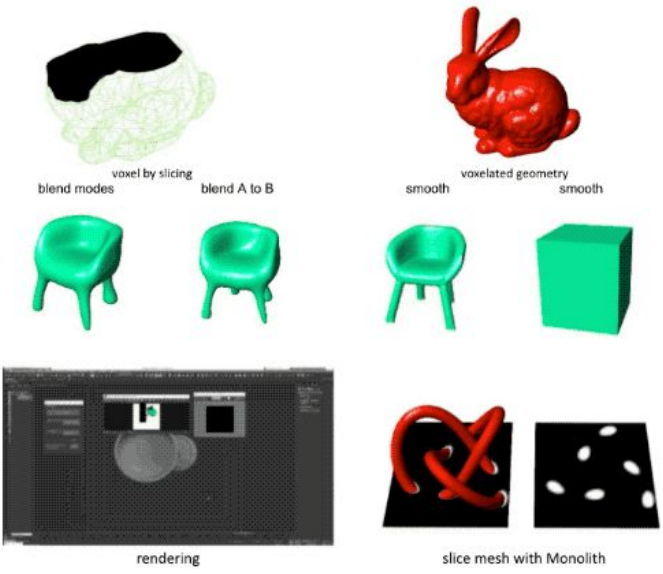
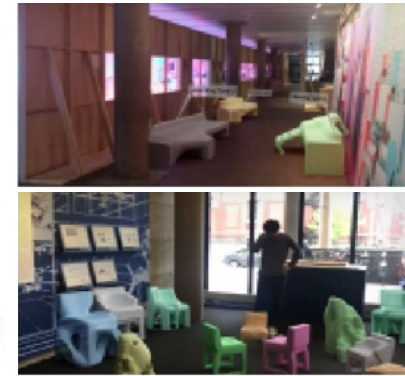
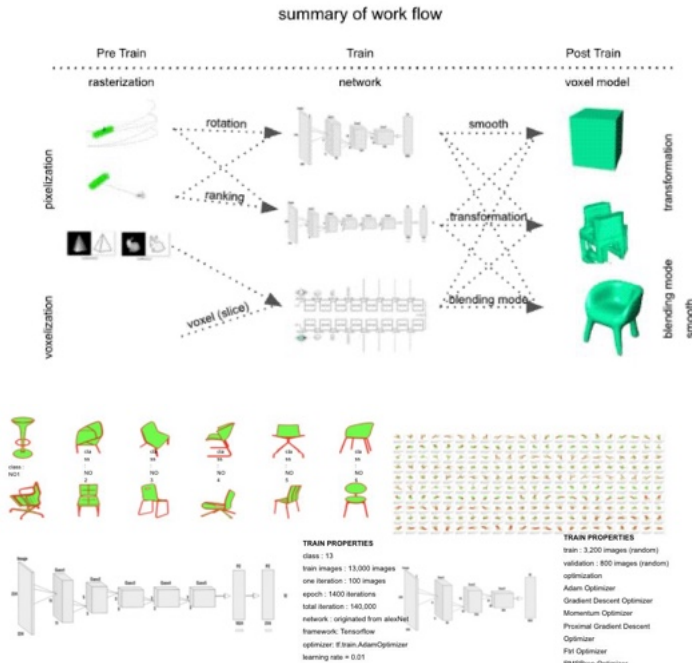


ABSTRACT

This thesis aims to explore the opportunities of remixing and resampling three-dimensional geometry data with the use of volumetric representations and machine learning in design. 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.

This 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 compared to conventional digital modeling techniques such as Mesh or NURBS modeling paradigms. It also describes characteristics of voxel space covering as pixelated and voxelated space, as a dense representation (implicit relations) compared to sparse representation (explicit relations), and its data manipulation in relation to voxel space. Similarities of voxel representations and two-dimensional images, enable us 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 voxelated 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 network(CNN) and Generative Adversarial Network(GAN), in order to show new types of geometries by voxel blending.

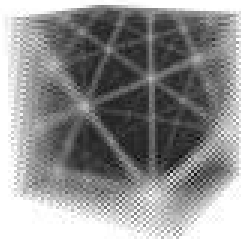




Harvard University
Graduate School of Design

Design workflows integrating Machine Learning and voxel representations

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



Advisor: Prof. Perazoglu, Michaelis, Harvard GSD

Advisor: Prof. Toshihiro Nagakura, MIT

KU Namju Lee

Thesis project, GSD

Geometry and Position Optimization

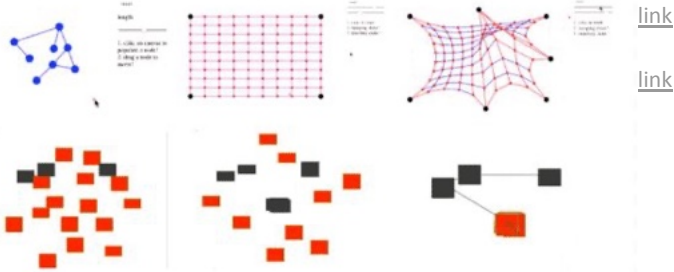
based on graph and spring model physics

Position Optimization

based on graph and spring model physics

Experimentation for overlapping text boxes

with constraints

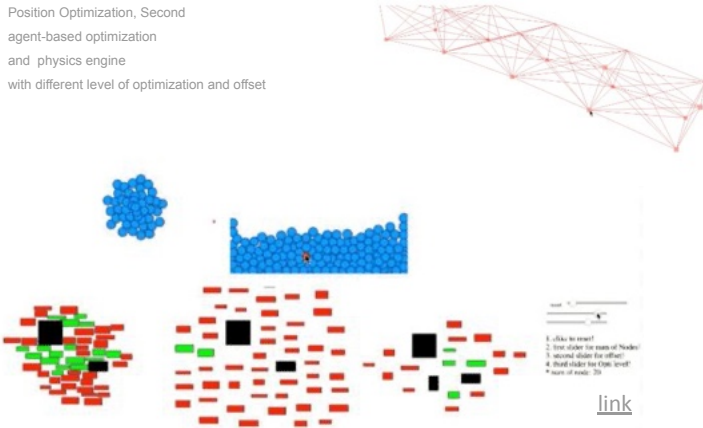


Position Optimization, Second

agent-based optimization

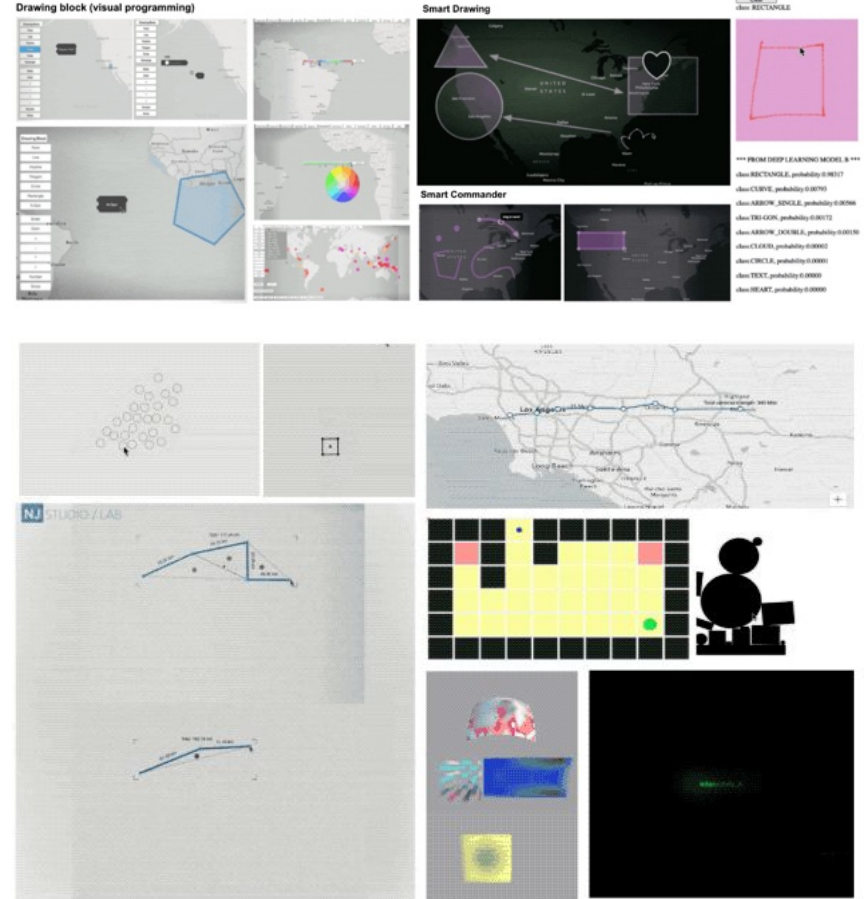
and physics engine

with different level of optimization and offset



Advanced Geometry manipulations

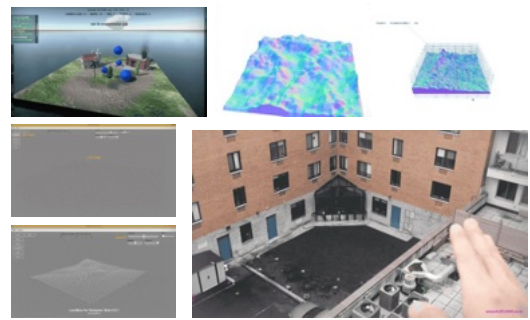
Dynamics, Spring, Voxel, Shader ...



LANDSCAPE & ENVIRONMENT

<https://namielee.github.io/nis-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

- Environment
- Solar Class
- Solar Evaluation with Surface
- Solar Evaluation with Points
- Land Evaluation with Points
- Land Evaluation with Surface
- Tree Class
- Grass Class

Reference



Figure 1 Solar Declination Resulting From Earth's Tilt

$$\delta = 23.45 \times \sin(360 \times (284 + \text{Day} / 365.25))$$

2. Solar Altitude

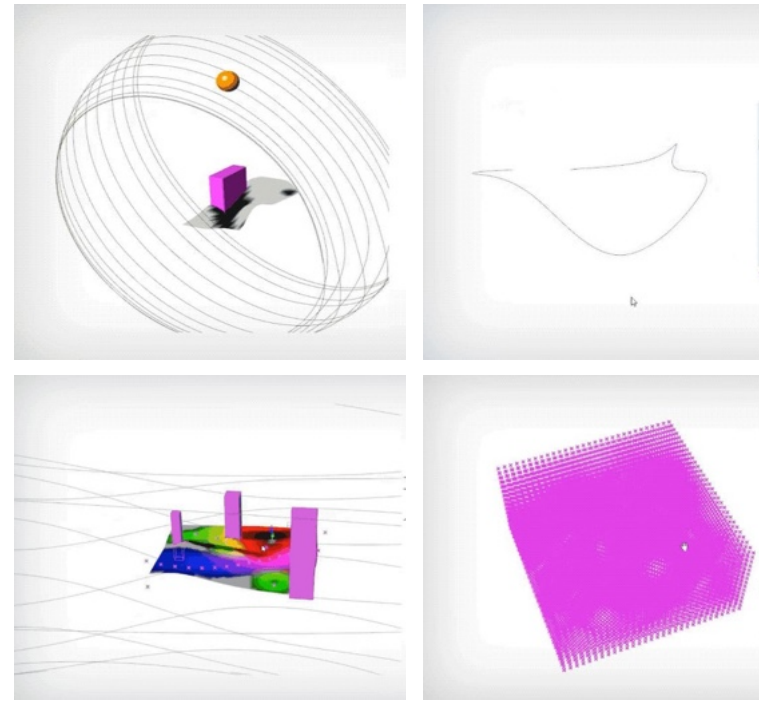
$$\theta = \sin^{-1}(\cos \delta \times \cos L + \sin \delta \times \sin L \times \sin H)$$

3. Solar Azimuth

$$\phi = \cos^{-1}(\frac{\sin \delta \times \cos L - \sin \theta \times \sin L}{\cos \theta \times \cos L})$$

Figure 2 Solar Altitude and Azimuth

$$\theta = \cos^{-1}(\frac{\sin \delta \times \cos L - \sin \theta \times \sin L}{\cos \theta \times \cos L})$$





Numerical Environment Utility

data in pixel and voxel, Version 2015

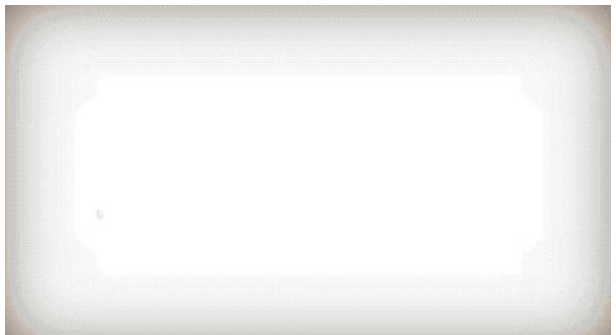
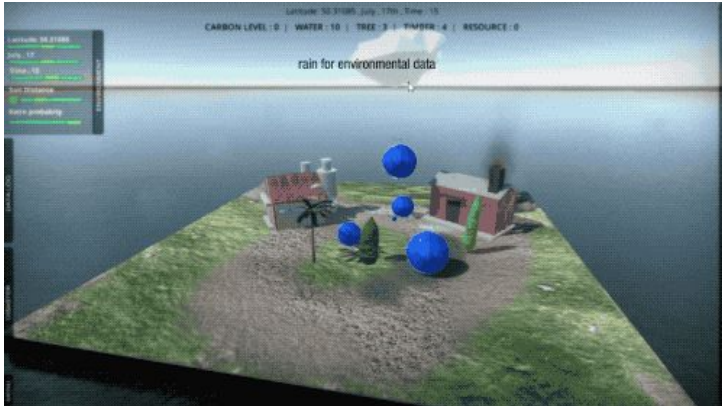
- Data View
- Data Visualization with Volume
- Data Visualization with Plane
- Data Average with Volume
- Data Average with Plane
- Local Visualization with Volume
- Local Visualization with Plane
- Data Help
- About Data
- About Numerical Environment

www.njstudio.co.kr



DESIGN SYSTEM & COMPLEX SYSTEM

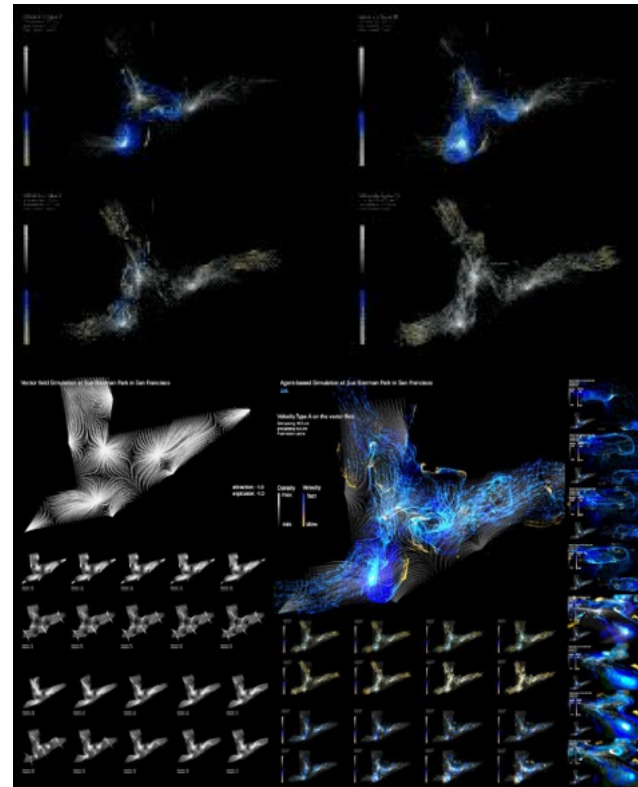
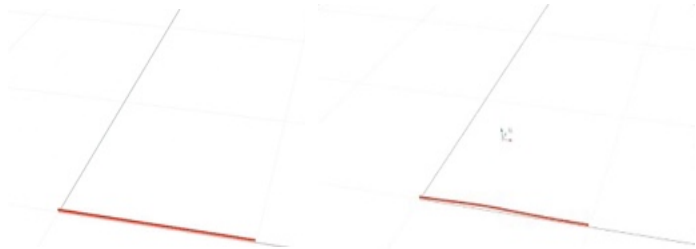
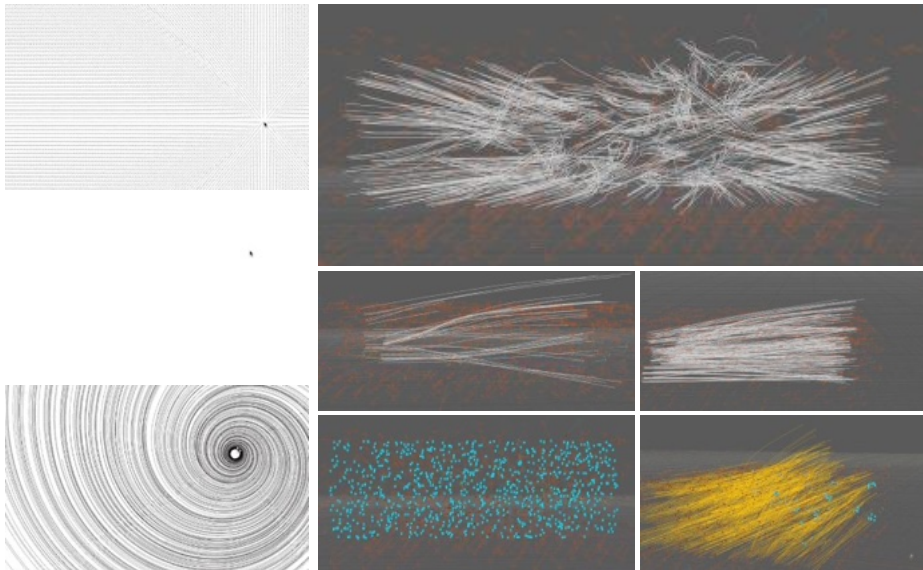
http://www.njstudio.co.kr/main/project/2016_SmallEnvir onments/2016_SmallEnvironments.html





Field & Particle

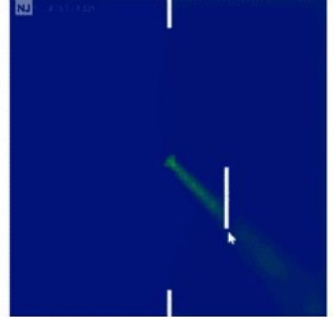
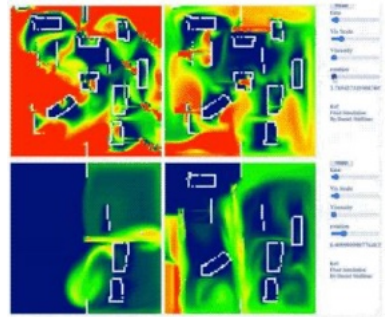
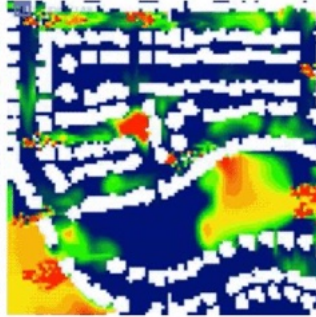
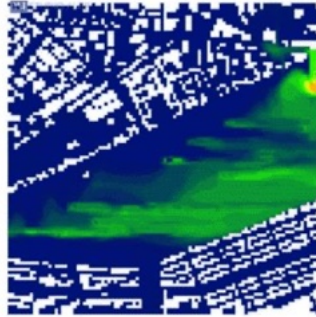
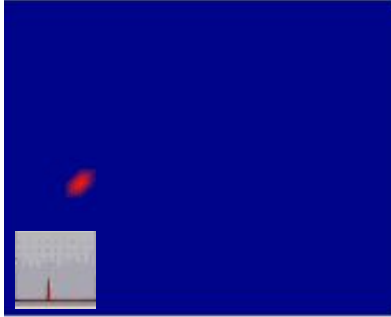
DYNAMICS



Field & Particle

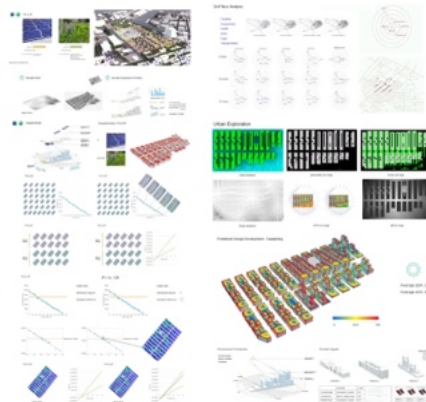
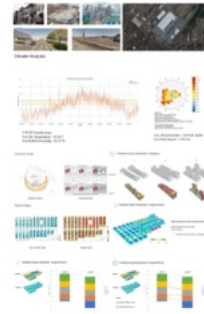
DYNAMICS

Fluid dynamics simulation- [Lab link](#)



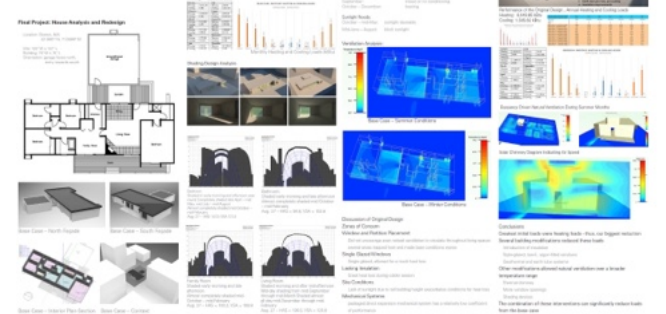
MODELING URBAN ENERGY FLOWS Sustainable Design Lab, MIT

Blair, January 2011
4.002.023 Modeling Urban Energy Flows
Prof. Christopher Reinhart
This class research, design, simulation, and visualization
Experimentation. One assignment from: Robert G. Simon, "Urban Energy"



COMPUTATIONAL FLUID DYNAMICS Experiment, Harvard GSD

Blair, June 2011
GSD 6.000 Building Simulation
Prof. Robert G. Simon
This class research, design, simulation, and visualization
Experimentation. One assignment from: Christopher Blair



FABRICATION & DIGITAL MOCKUP

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

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

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

ARCHITECTURE COMPILER AN ADD ON FOR GRASSHOPPER FOR FABRICATION

The screenshot displays the Architecture Compiler interface, which includes several toolbars for defining components and materials. A central workflow diagram shows the sequence of operations: 'Define Component' -> 'Define Material' -> 'Define Assembly' -> 'Define Fabrication'. Below the workflow, there are detailed views of component definitions, material selection options, and assembly configurations. The interface is designed to facilitate the digital fabrication process by linking architectural models to manufacturing parameters.

Double-layer Strip Chair
 Arch 209, Banding & folding structure
 Date: Spring 2015
 Type: Academic work
 File format: simulation and digital mockup
 Collaboration: Multiple students
 - Wenzhe Peng, Muhammad Siddiqui
 - Prof. Simon Schuber, Kyle Donahue
 LIS

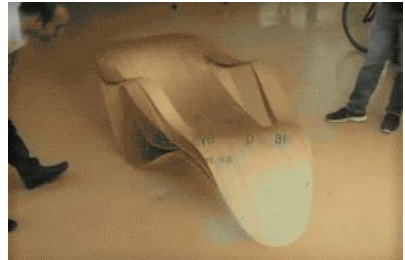
This collage illustrates the design and fabrication process for the Double-layer Strip Chair. It features several key elements:

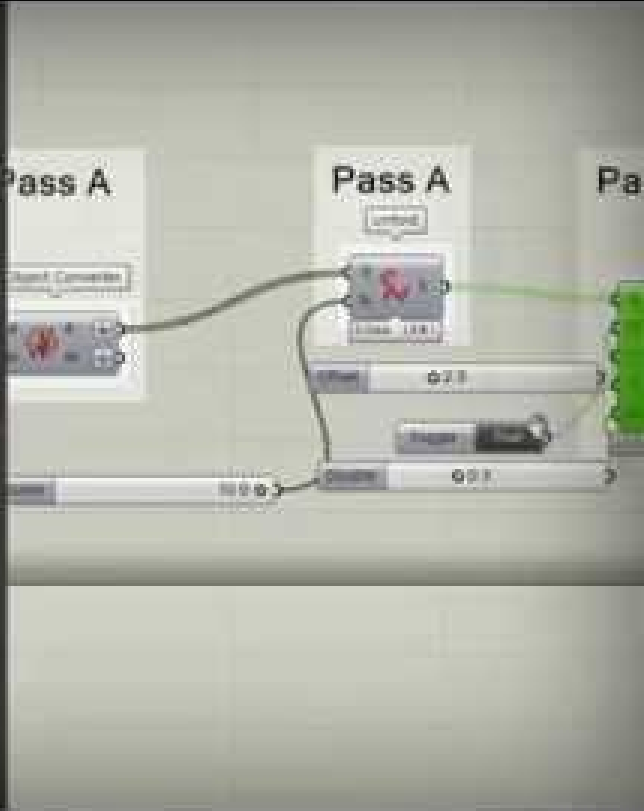
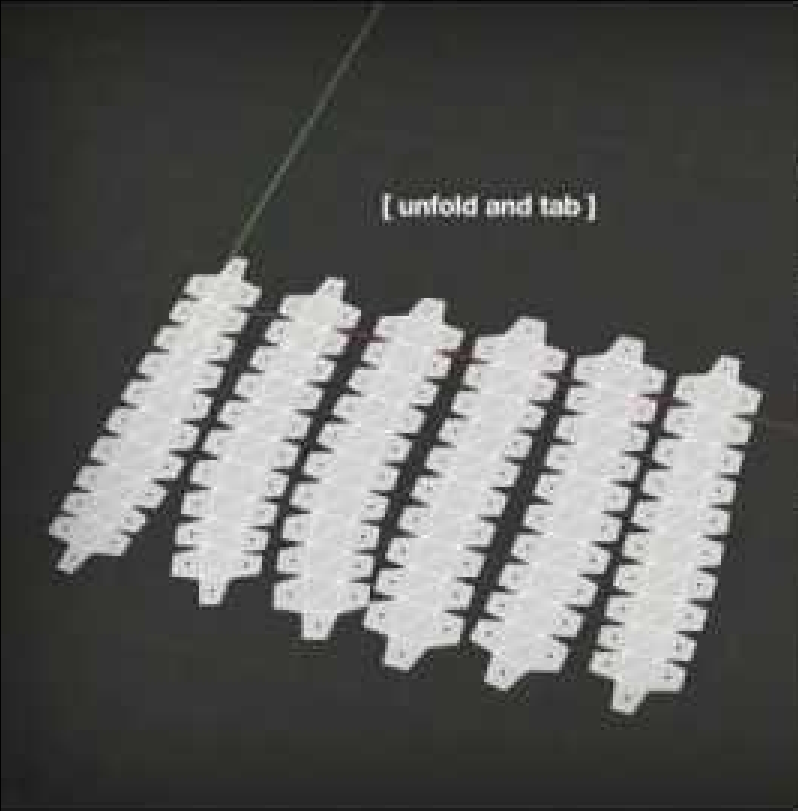
- Mechanical analysis:** A series of diagrams showing the structural behavior of the chair's frame under load, with stress distribution maps and force vectors.
- Bending Simulation for a strip:** Multiple images showing the digital simulation of how individual strips of material will curve and interact when assembled into the chair's form.
- Material test:** Photographs of physical experiments where strips of material are bent to test their flexibility and strength.
- Final output and fabrication:** Images showing the final digital model and the physical chair being constructed from the fabricated strips.
- Experiment of cutting positions:** Diagrams and photos showing how different cutting patterns affect the final shape and stability of the chair.

Parasitic Urban Furniture (Fabrication)
 Team: Multiple students, Hanyu Cao
 Institution: Yale University, School of Architecture, Jonathan Borwick, Luis Angel LIS

This collage presents the Parasitic Urban Furniture project, which focuses on creating modular, parasitic seating for urban environments. Key components include:

- Conceptual models:** 3D renderings and diagrams showing how the furniture pieces attach to existing structures like benches or utility boxes.
- Fabrication details:** Close-up images of the manufacturing process, including the cutting and assembly of the furniture's components.
- Site photographs:** Images showing the furniture installed in various urban contexts, demonstrating its adaptability and integration with the environment.
- Material and structural analysis:** Diagrams and photos showing the materials used and how they are joined to ensure durability and ease of installation.





NJSTUDIO 2015 DIGITAL MOCKUP DEMO REEL

FIFTH EDITION, SELECTED WORKS SINCE 2004

njstudio@gmail.com

www.njstudio.co.uk

MATERIAL & COMPUTATION

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

TRMRESPONSIVE FABRIC AND BLIND

Nano Micro Macro: Adaptive Material Laboratory, HARVARD GSD

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

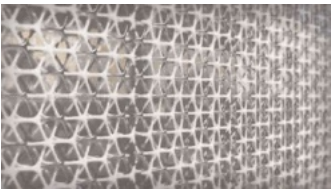
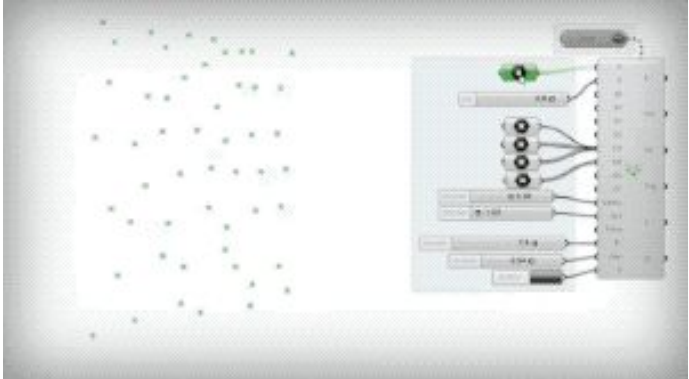
Website [Link](#)

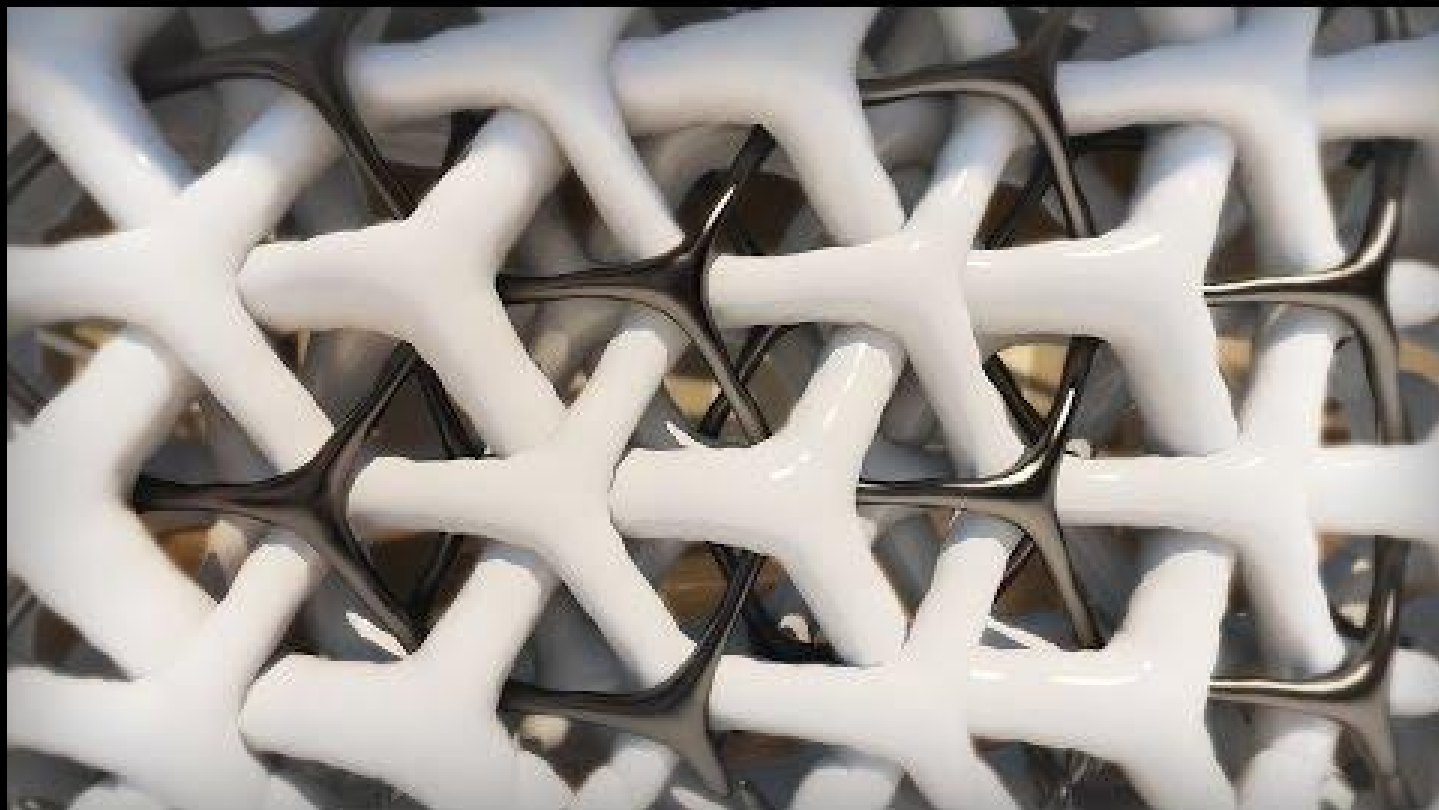
Concept
 This design responds to thermal changes by varying the scale of porosity. The system consists of two separate membranes: one is rigid and the other is swelling. Basically, as the second membrane swells, cavities within the surface gets smaller to respond to outside thermal conditions.

Core Technology
 Thermo responsive Swelling

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

The diagram illustrates the design process from concept to final structure. It includes a flowchart, various cross-sections and top-down views of the porous lattice, and a photograph of the physical installation in a room.





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

FABRICATION & COMPUTATION

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

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

CERAMIC MORPHOLOGIES Cevisama Installation 2017 HARVARD GSD

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

Role taken : **computation design and visualization**

Sponsor: ASCERC Tile of Spain & Cevisama

Coordinator: ITC, Javier Mira Peidro

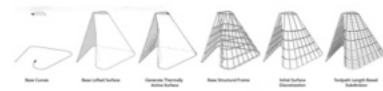
Production: Instituto de Tecnología Cerámica, Pilar Gómez Tena, Carmen Segarra Ferrando, Aroa García Cobos

Installation: Grupo on Market

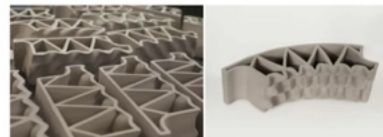
Documentation: Fernando García del Castillo López

[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.

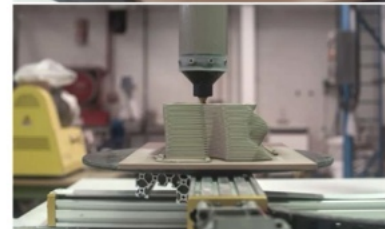
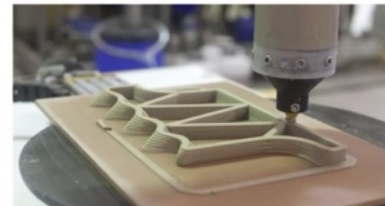


The pavilion is meant to showcase the expressive potential of ceramic 3d printing, and test the adaptation of principles of thermodynamic heat transfer to 3d printed geometry. The shape and design are products of current research related to the thermal performance of naturally ventilated spaces – the 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 contoured and 3d textured. In addition to creating a unique relationship between interior and exterior space, the geometry of this insulating surface relates to research on the optimal dimensions for thermodynamic heat transfer.

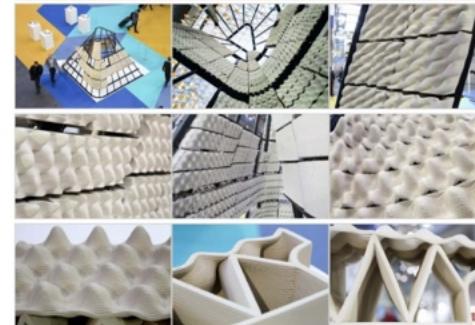
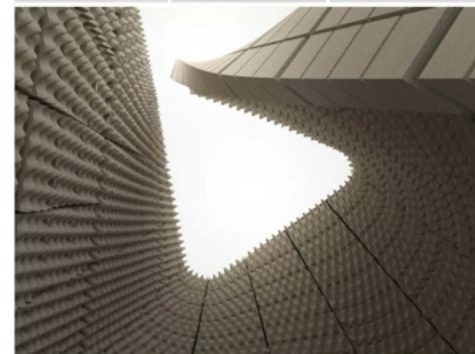
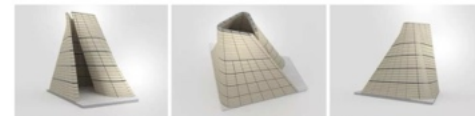


The thermal agenda is embedded in the logic of both the pavilion's interior surface geometry and the configuration of its overall form. Its pyramidal shape facilitates upward air movement, and the interior geometry impacts the thermal exchange between ambient air and the interior mass/surface. The contoured, sinusoidal texture 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. 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.

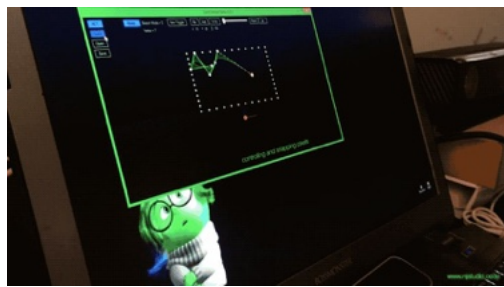
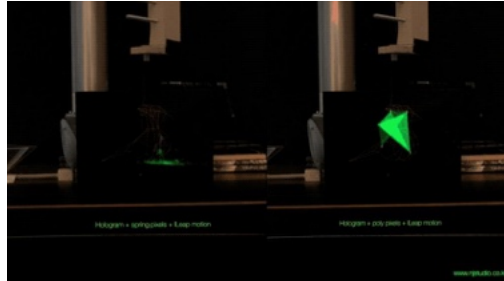


Measuring 3 m tall, with a footprint of 3.2m x 3.6m, the pavilion consists of 552 unique elements ranging from 260-545 mm in length, and 70-150 mm in height. 184 elements, representing 1/3 of the entire structure, are displayed in the current configuration shown at the 2017 Cevisama Fair in Valencia, 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://namiulee.github.io/nis-lab-public/work?id=2015-sketch-hand-mechatronic-optic>



AUGMENTED INTERACTION, HARVARD GSD SketchHand[Development]

Date : 2015
Type : Academic project
Class : Mechatronic Optics, Fall 2015
Prof. Andrew Witkin

Collaboration : Amira Abdel-Rahman
Role taken : design, research, and software development

Website : <http://namiulee.github.io/nis-lab-public/work?id=2015-sketch-hand-mechatronic-optic>

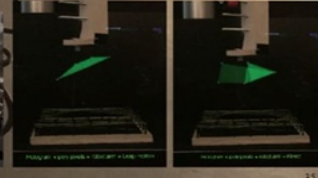
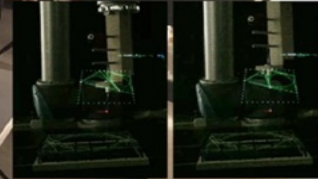
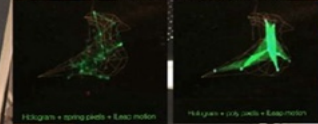
Capture
Leap Motion
Kinect

Design
Poly-Pixel
Spring Pixel
3d Weaving
2d Weaving

Analyze
Weaving Pattern Chosen
Load and Supports Indicated
Von Mises stress and Principal Stresses' Values and Vectors Calculated
Stronger and Thicker Wires in the direction of high stress

Project
Hologram Projection
Direct Projection

Fabricate
Toolpath Generation
Interactive weaving
Different Thread Types



Harvard University GSD
Mechatronic Optics (GSD 0645000)

SKETCHHAND

beta 0.0.5 , version for hologram

https://github.com/namjulee

NJCHANNEL PROJECT

Education

APPENDIX

EDUCATION

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

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

Youtube Korean
<https://www.youtube.com/channel/UC3Z42ue9C7E139h5clK1dW>

Medium
<https://ni-namui.medium.com/>

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

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

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

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

Daum Brunch - link

NJ's Computational Design Series

초급: 위으면서 입문하는, 모두의 디자인 코딩

중급: 따라 하며 입문하는, 모두의 디자인 코딩

고급: 데이터 & 디자인 융합에이셔널 디자인

처음 코딩을 접하는 디자이너에게 - link

NJ Channel Project, 콘텐츠 & 학습 자료 인덱스 - link



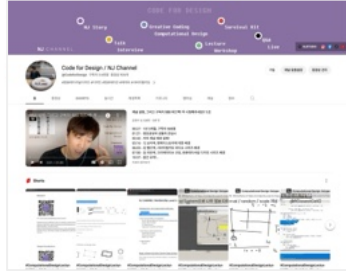
NJSTUDIO project and portfolio channel

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

10/10/2020 4:00 read
Computational Design, NJSTUDIO



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

10/10/2020 4:00 read
Digital FUTURES 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 years. The workshop consists of three key parts: (1) processing and visualizing data (2) enumerating geometries (3) developing a pipeline for an interactive
<https://ni-namui.medium.com/introduction-to-computational-design-data-geometry-and-visualization-482cfdea3851>
<https://codepen.io/namuijee/pen/1191082922>

Computational Design Thinking for Designers

10/10/2020 4:00 read
Computational Design

The keywords could help designers to start thinking like a computational design specialist. Computational thinking in design asks you holistic approaches to resolve a small design problem while at asking you an extremely isolated process to find 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 & Contexts
Writing Instructions

THE METHODOLOGY & APPROACH

from Whole to Parts & from Part to Whole
from Simple to Complex & from Complex to Simple

Geometry as Data Structure and Visualization

10/10/2020 4:00 read
Social Algorithms 2020, Computational Design

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

Lecture:
1) File format(CSV, JSON, GeoJSON, Image)
2) Geometry as Data Structure
3) Remap, interpolation, Generalization
3) Object-oriented programming(OOP) pattern
4) Visualization

DATA STRUCTURE

Structured data - CSV
Semi-structured data - JSON, GeoJSON - link
Image: [Elastic Search - ELM - link](#)

[Preparation Pattern / Preprocess Class](#)
Software design pattern: [link](#) - [link](#) - [link](#) - [link](#) - [link](#)
Inheritance (object-oriented programming) [link](#)

<https://ni-namui.medium.com/geometry-as-data-structure-and-visualization-482cfdea3851>

6 Digital Mapping using ArcGIS JSAPI

10/10/2020 4:00 read
Digital FUTURES WORLD : ARCHITECTS UNITE Workshops

Day 6: Digital Mapping using ArcGIS JSAPI
Introduction to JSAPI and the Development of a Mapping App

Keyword
Projection, Remap, Interpolation, Generalization, ArcGIS JSAPI, Gestalt Principles, Principles of Graphical Integrity, Bertin's Visualization design space

Research Overview
* [Data Flow, Metadata, Query, Construction](#)

Lecture:
1) Projection, remap, interpolation
2) Generalization
3) Understand modify Object-oriented programming(OOP) pattern

Workshop: Codepen, Github
1) Develop a mapping app with JSAPI based on the boilerplate code

Additional note:
1) data visualization using d3.js
2) data visualization using [Dashboards](#)

<https://ni-namui.medium.com/6-digital-mapping-using-arcgis-jsapi-626e108624b>

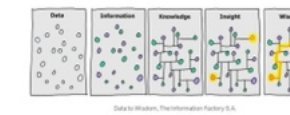
Discrete Urban Space and Connectivity

10/10/2020 4:00 read
Social Algorithms 2020, Computational Design

Subtitle: Partition & Relationship

Keyword
Data Structure, Graph, Matrix, Flat, Visual, Discretization, Partition, Connection, Search

Workshop Reference
1. Computational Design Thinking for Designers - [link](#) (Eng)
2. Data & Design - [link](#) (Eng) - [link](#) (KOR)



We are able to answer these questions below.

<https://ni-namui.medium.com/how-to-capture-and-process-spatial-data-in-design-492b3bd0a81>

<https://ni-namui.medium.com/discrete-urban-space-and-connectivity-492b3bd0a81>

Computational Design

Lecture Series:

Tistory Search - <https://computationaldesign.tistory.com/3?category=9371138>

NJ's Computational Design Lecture series - <http://bit.ly/2SoBRq0>

- 37. 우리는 무엇을 배우면서 사는가 feat. 언어와 컴퓨터이셔널 사고, 그리고 사고의 도약 - [link](#)
- 36. 코딩공부와 수학 그리고 공부할것 feat. 4차 산업혁명 그리고 디자인 - [link](#)
- 35. 함수추출 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! 컴퓨터이셔널디자이너로 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, 데이터의 흐름 / CAD data pipeline - [link](#)
- 28. SA 7.0 Lecture 2. 디자이너를 위한 컴퓨터이셔널 툴링 / Computational Thinking For Designer - [link](#)
- 27. SA 7.0 Lecture 1. 데이터 & 디자인 / Data & Design - [link](#)
- 26. 곱하기 어떻게 볼까? 추상을 통한 상상? 컴퓨터이셔널/크리에이티브 코딩 - [link](#)
- 25. 합합문화로 보는 새로운 패러다임 그리고 컴퓨터이셔널 디자인의 운명 - [link](#)
- 24. 정규화 & 보간 & 이상치 / normalization & interpolation & outlier - [link](#)
- 23. 프로젝트션 & 리맵 / Projection & Remap - [link](#)
- 22. 서바이벌기드 11. 디자이너에게 코딩이란 / 나에게 코딩이란 / 코딩을 하는 이유 - [link](#)
- 21. 내가 생각하는 컴퓨터이셔널 디자인 / 워크숍 강좌를 만드는 배경 / 디자인 데이터 / Design & Data - [link](#)
- 20. 컴퓨터이셔널디자인을 바라보는 시각과 오해 - [link](#)
- 19. 건축 3D 렌더링에 관한, 어느 건축가의 질문들.../ 건축 시각화 - [link](#)
- 18. 매핑 (건축, 도시) / Mapping for Urban and Architecture - [link](#)
- 17. 도시, 건축 렌더링 팀 / Architectural & Urban Rendering tips / 건축 시각화 - [link](#)
- 16. Mouse Event / 마우스 이벤트, CAD System - 캐드시스템 - [link](#)
- 15. Active Command - 엔터브 커맨드, CAD System - 캐드시스템 - [link](#)
- 14. Harvard GSD Technology 그리고 MIT Computation 지원준비, 프로그램 비교, 및 컴퓨터이셔널 공부 준비 방법 - [link](#)
- 13. 자료구조, 픽셀, 복셀 / Data Structure for design , pixel and voxel data structure 2/2 - [link](#)
- 12. 자료구조, 그래프 / Data Structure for design , Graph 1/2 - [link](#)
- 11. 라이노 파이썬 / Rhino Python, 공부법 - [link](#)
- 10. HTML Canvas, 데이터 시각화, 크리에이티브 코딩 - [link](#)
- 09. 건축 시각화 / Architectural Visualization - [link](#)
- 08. 데이터 시각화 / Data Visualization - [link](#)
- 07. 디자이너를 위한 프로그래밍 언어 2/2 - Typescript(Javascript) - [link](#)
- 06. 디자이너를 위한 프로그래밍 언어 1/2 - C# - [link](#)
- 05. 파이썬 (Python) 배우야 할까? 장단점을 알아보자! - [link](#)
- 04. 쉽게 이해하는 클래스(Class) - [link](#)
- 03. VR / AR 꼭 해야 할까? 2019 버전 - [link](#)
- 02. 건축 도시 디자이너를 위한 프로그래밍 테크트리 - [link](#)
- 01. 컴퓨터이셔널 사고 (핑킹) / Computational Thinking - [link](#)
- 00. 파라메트릭 디자인? / Parametric Design - [link](#)
- 00. 컴퓨터이셔널 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 컴퓨터이셔널

- QnA 01. 어느 고등학교생의 질문 / 건축 파라메트릭 디자인 예제
- QnA 02. 건축가의 일반적인 질문 2차 (건축컴퓨팅실무)
- QnA 04. 건축컴퓨팅을 공부하고 싶으신 건축가형남과의 대화
- QnA 05. 코딩과 건축컴퓨팅에 관심이 많으신 건축가형남과의 대화
- QnA 06. 건축가의 일반적인 질문 (건축컴퓨팅실무응용)
- QnA 11. 어떤 질문은 건축 디자이너의 질문
- QnA 15. 복셀(Voxel)과 컴퓨터이셔널 디자인 그리고 건축 디자인
- QnA 16. 파라메트릭(Parametric Design)과 미적분
- QnA 17. 내가 생각하는 그라스하퍼(Grasshopper)의 단점과 개인적인 생각
- QnA 19. 파라메트릭 디자인 배우려면 어디서부터 어떻게 시작해야하나요?
- QnA 21. 5G기술과 건축산업(설계 협업 및 시각화 VR), 정말 유용 하나?
- QnA 22. 내가 생각하는 그라스하퍼(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. 대학원의 질문, 대학교, 대학원, 파라메트릭 디자인 스튜디오 어떻게 접근 할까?
- QnA 36. 파이썬 그리고 그래픽 툴(맥스, 마야, 라이노...)
- QnA 37. 프로토타입 디자인 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. 데크니컬 아티스트 공부 방법? 책? 학원?
- QnA 44. 네이버 카페, 그래서로써 풀린 질문 / 코딩을 공부하는 자세

3.3 인공지능, 데이터 그리고 시각화

- QnA 07. 데이터 시각화 도구(tools) 그리고 개인적인 생각
- QnA 12. 데이터시각화가 좋은 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), 컴퓨터이셔널 전공을 시작하는 학생 질문

3.4 취직 / 진학 / 유학

- QnA 08. 컴퓨터이셔널 직업군 및 준비 자세
- QnA 09. 직장상사가 내 미래에 도움이 안될 때, 회사를 떠나야하나? 존책에서 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/컴퓨터이셔널/뉴미디어/디자인 직업군, 어떻게 준비하면 좋을까요?
- QnA 34. 유학 고민 많을 때, 실내건축학과 전공자의 M.Arch 유학에 대한 고민
- QnA 35. 컴퓨터이셔널 디자인 유학을 준비하는 학생의 질문
- QnA 40. 건축 컴퓨터이셔널 유학 그리고 파이썬 코딩 공부
- QnA 41. 데이터를 활용한 도시 설계? 공부 전략? 그리고 (MIT SENSEable City Lab 연구소)
- QnA 45. 컴퓨터이셔널 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/@ninamju/91>

Video Playlist - <https://www.youtube.com/playlist?list=PLueN1YuGdKfKcCY8B8oK4H4fbcWV245o3>

Medium : <https://ninamu.medium.com/numeric-network-analysis-post-covid-19-urbanism-6-6-rule-46297886020>

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

이남주 / NJ Namju Lee / nj.namju@gmail.com
우정현 박사 / Junghyun Woo / axuplatform@gmail.com

SA 7.0 Unit 2 한국어 강좌

- 0. Introduction Unit 2 - Medium link
유닛 2수업 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
디자인을 위한 컴퓨터시각화 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 보행 환경 - 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 toolbox를 활용한 도시 공간정보 분석 예시 - 전체버전
- 7. Lecture, Discrete Urban Space and Connectivity - Medium link
이산 도시 공간과 연결성 - 전체버전 - 편집버전
- 8. Lecture, Geometry as Data Structure and Visualization - Medium link
데이터 구조로서의 지오메트리 그리고 시각화 - 전체버전 - 편집버전
- 9. Workshop, Pedestrian Volume Studies - Medium link / Post-COVID-19 Urbanism - Medium link
보행자 이동성 정보 수집 방법 / 포스트 COVID-19를 대비한 도시 환경 계획 및 아이디어 - 전체버전
- 10. Workshop, Data Visualization, Numerical Image Utility - Medium link
데이터 시각화 / 이미지 툴 - 전체버전

Discrete Urban Space and Connectivity

NJ Namju Lee Jul 30, 2020 - 5 min read

SA/Social Algorithms) 2020, Computational Design

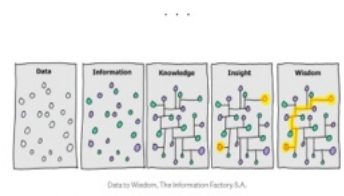
Subtitle: Partition & Relationship

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)



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

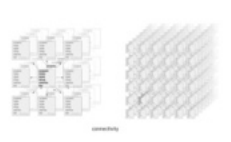
1. Graph



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 beam or node as 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, Time series, Zillow, etc

Delunary triangulation / Voronoi diagram

Discrete space - Space Partitioning

Quad Tree / Octree / Bin System

Axis(AABB) / 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 (Games, freeway(Highway), subway, etc, etc...)
Folder structure as Graph - link
Programming execution 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 Rhino3d: link

NISTUDIO Presentation slide

Data structure as Graph
BSON / GeoJSON as Graph
Matrix (link) Data(link) and Voxel(link) as Graph

AI & Data for Design

Link: <https://computationaldesign-listory.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

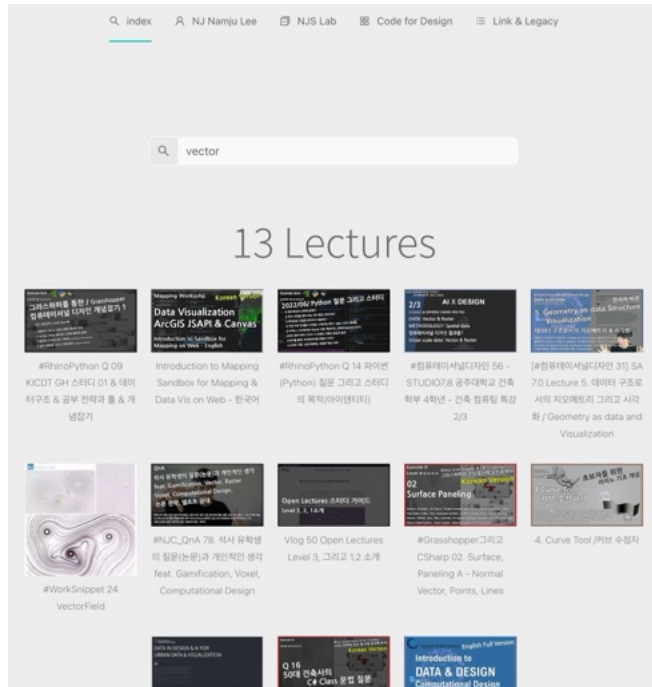
Typescript Basic, Tensorflow JS

Project

- Project, Smart Map Tracer, ESRI Storymaps Hackathon - video
- Project, Smart Drawing - Writing / Video / Demo
- Project, Remixing & 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 & Smart Drawing
- link Linear-regression, Polynomial Regression, Regression Model, XOR
- Codepen - Tensorflow clayground stater, Typescript

SEARCH

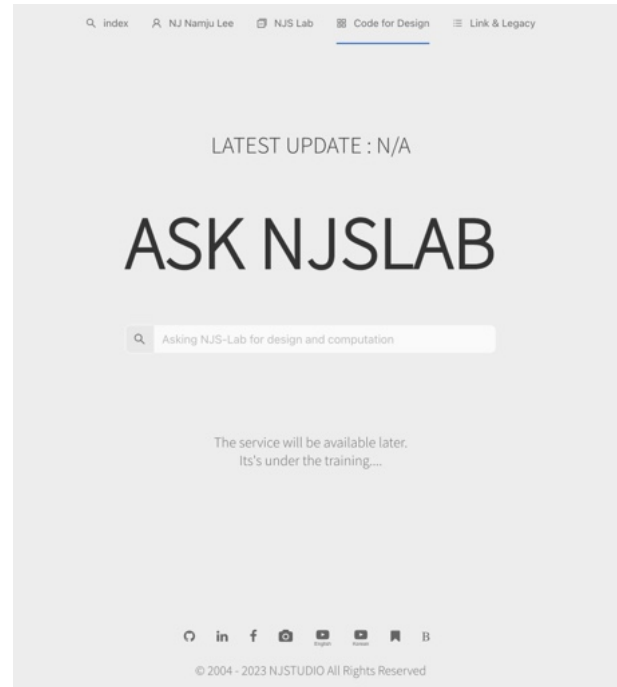
Design and Computation



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

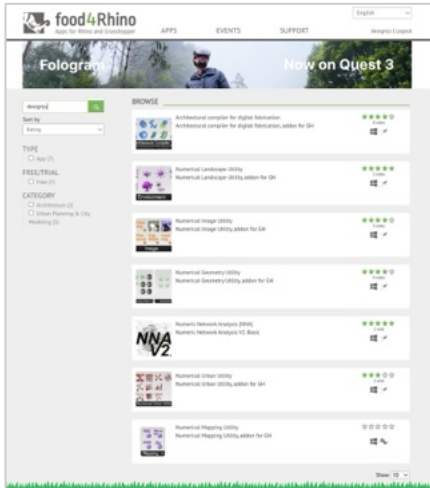
LLM

for Design and Computation

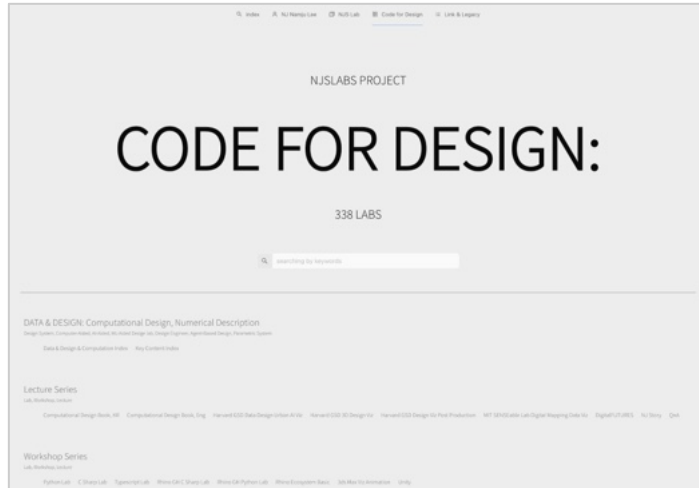


<https://namjulee.github.io/njs-lab-public/search>

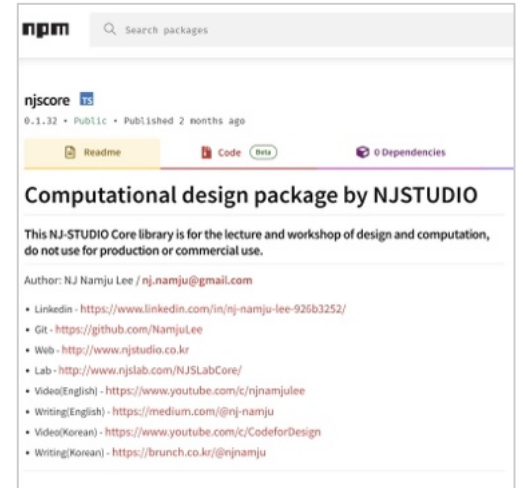
Rhino & Addon



Lab / workshop



njscore.js



Digital mapping and data visualization - [link](#)

Introduction to Computational Design, Harvard GSD JTerm Workshop 2023

Harvard GSD JTerm 01: Course Introduction & Review TOC
Graduate School of Design

DATA IN DESIGN & AI FOR URBAN DATA & VISUALIZATION

01:00:00

#01: Course Introduction & Review TOC

다음에서 보기: YouTube

DATA & DESIGN, AI FOR URBAN DATA AND VISUALIZATION

Data, Design Computation, Artificial Intelligence, Visualization, Harvard GSD J Term 2023

link

<https://namijulee.github.io/njs-lab-public/work?id=2023-harvard-gsd-jterm>

Workshop - Lab

Digital-Mapping Lab

1. Mapping and Visualization
2. Programming and Data Flow
3. Station
4. CIVITAS Point
5. ZONE Point
6. ZONE Line
7. NEOTOM
8. Plugin
9. Plugin Interaction
10. Dynamic Box
11. Graph based Clustering
12. Dynamic Urban Space and Connectivity
13. VNA Explorer
14. Network Preparation
15. Network Search(MFD)
16. A Heat Graph
17. A Heat Grid

Map showing data points (red, green, blue, orange) overlaid on a street map of Cambridge, MA. Labels include Levington, Belmont, Waltham, Watertown, Cambridge, and Needham.

<https://namijulee.github.io/Data-Design-AI-for-Urban-Data-and-Viz-Harvard-GSD-public/lab/digital-mapping-lab>

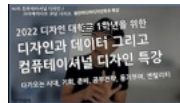
21 세기 데이터 기반 사회

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.

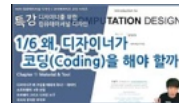
Reference : <https://webzine.kps.or.kr/?p=4&idx=274>

서울여자대학교



[link](#)

연세대학교 특강



[link](#)



감사합니다 :)

[NJ Namju Lee](#)

nj.namju@gmail.com

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>