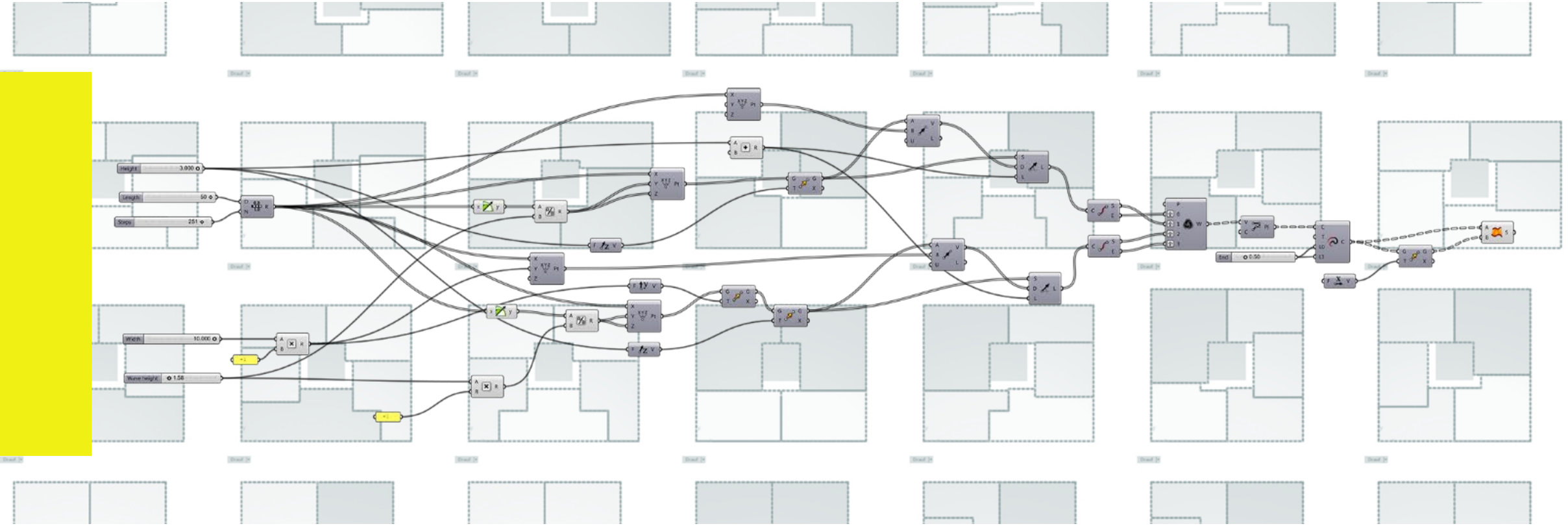
Parametrisierung als Methode zur Unterstützung des Entwurfsprozesses



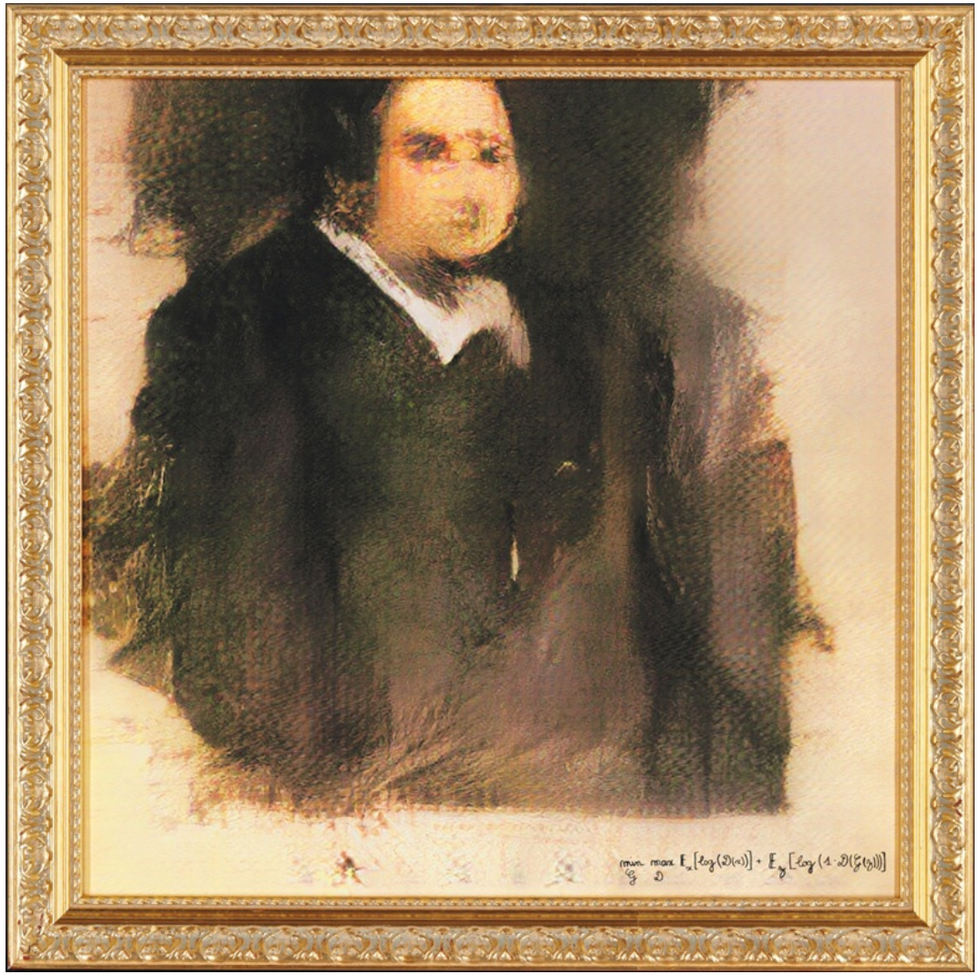
Wissam Wahbeh

- Dipl. Arch. (Damascus University, Syria)
- European Master (Roma Tre University, Italy)
- Ph.D. (Sapienza University, Italy)
- Post-Doc (IGEO, FHNW University of Applied Sciences and Arts, Switzerland)
- Wissenschaftlicher Mitarbeiter (Institute Digitales Bauen FHNW, Switzerland)
- Schwerpunkte:
  - VDC
  - Parametrisches Design
  - Scan-to-BIM
  - Bildbasierte 3D-Rekonstruktion

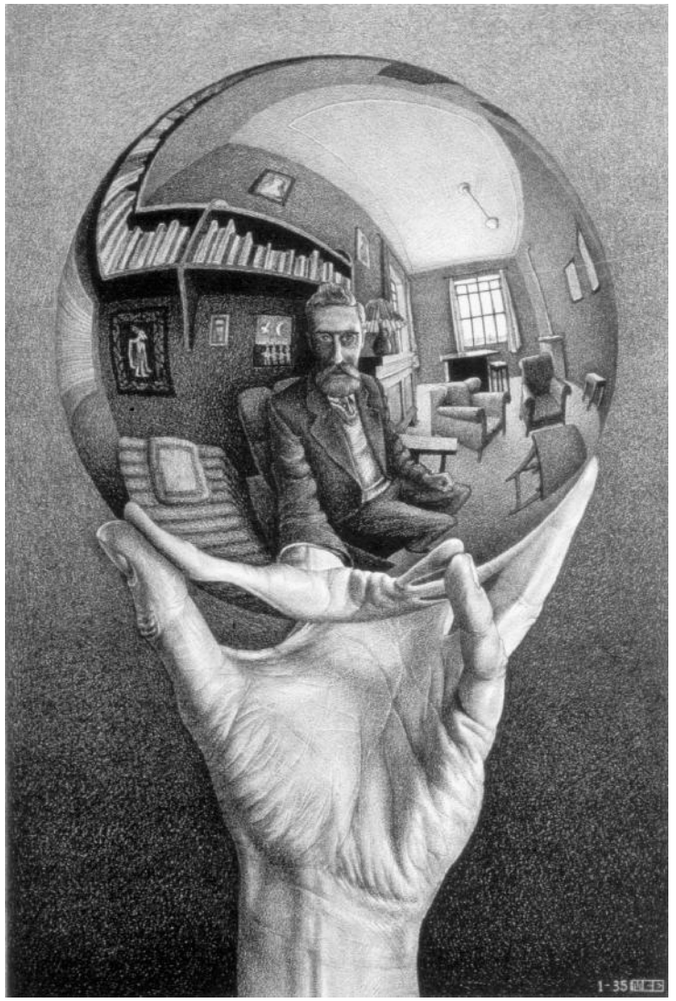
Portrait of Edmond Belamy, 2018

Created by GAN (Generative Adversarial Network).

Sold for **$ 432,500**
on 25 October 2018
at Christie's in New York.



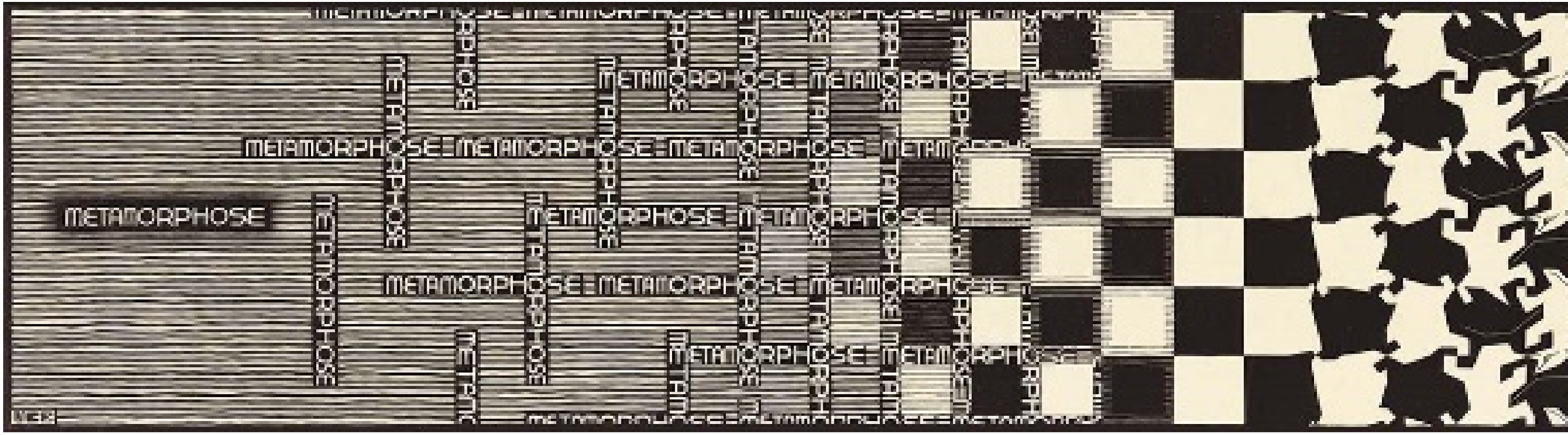
Quelle: www.christies.com



Quelle: www.mcescher.com

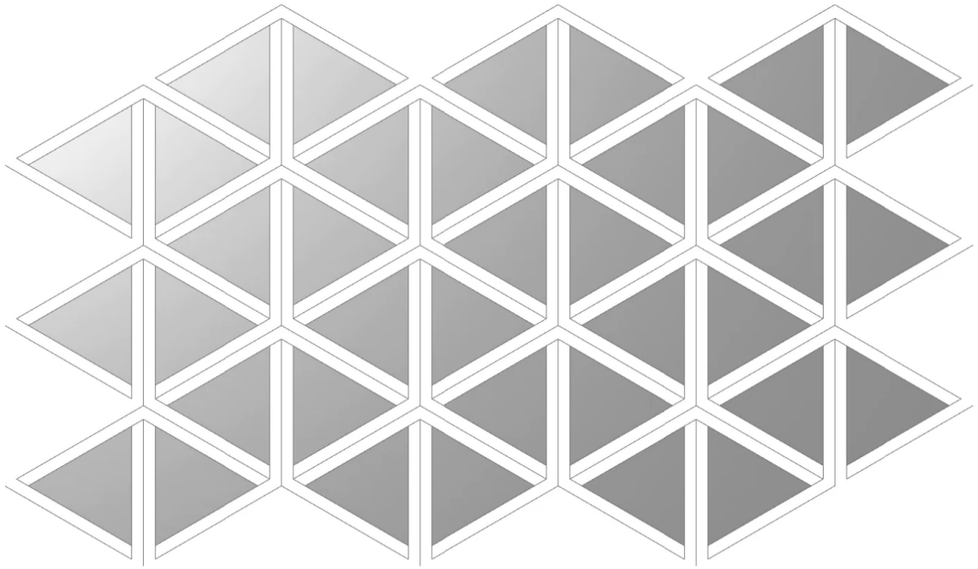
Quelle: www.mcescher.com

Metamorphosis II

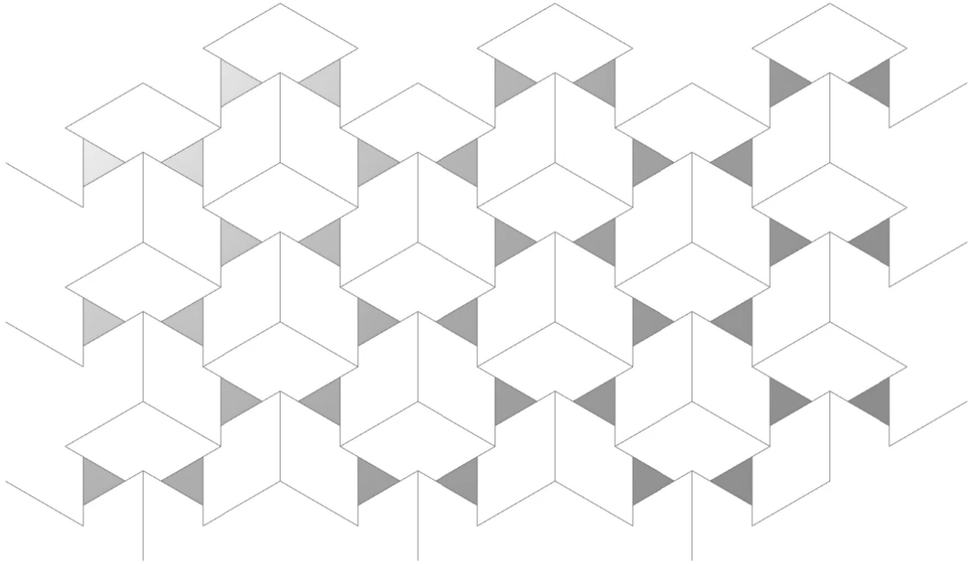


Quelle: www.mcescher.com

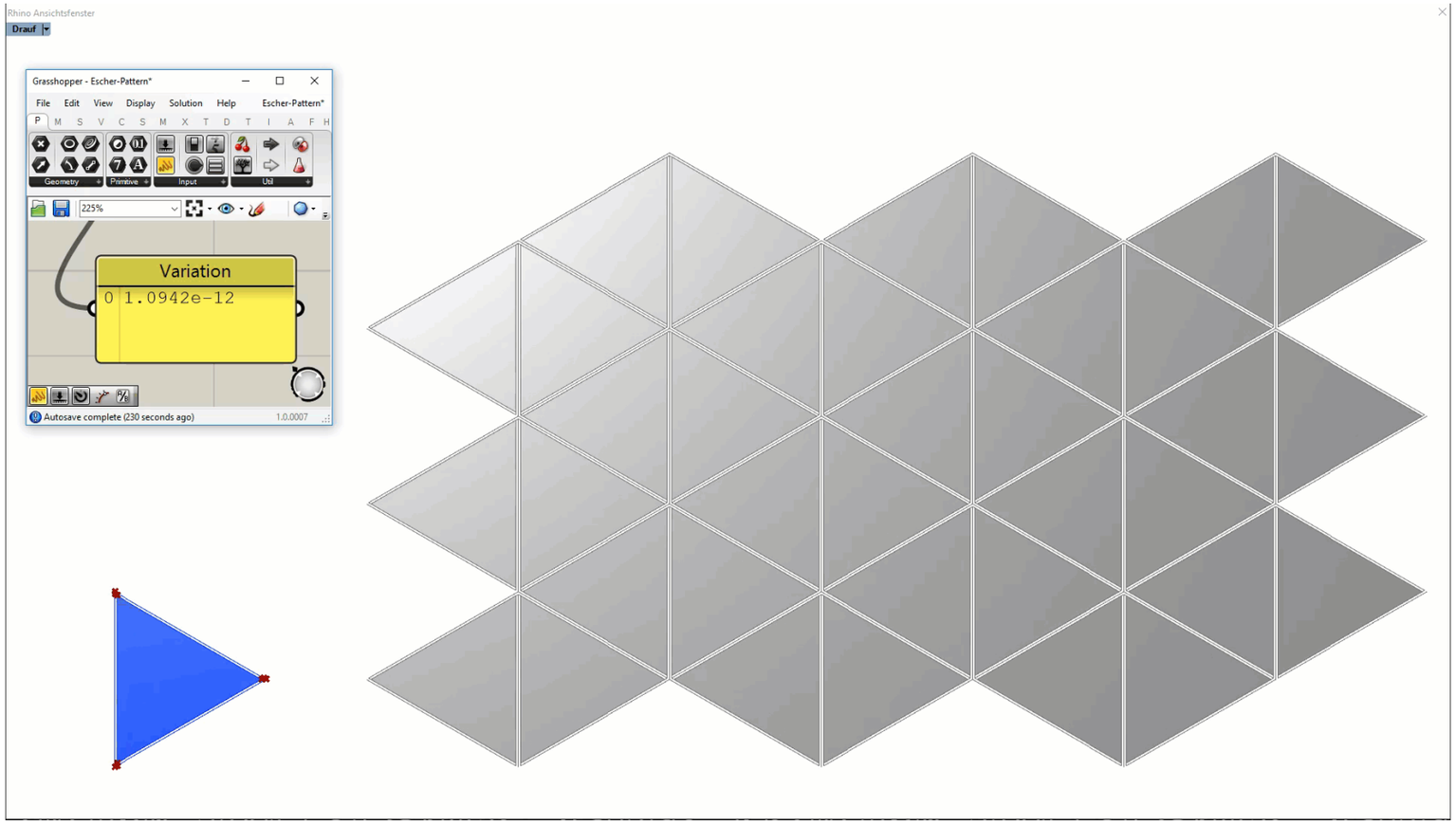
Muster 1



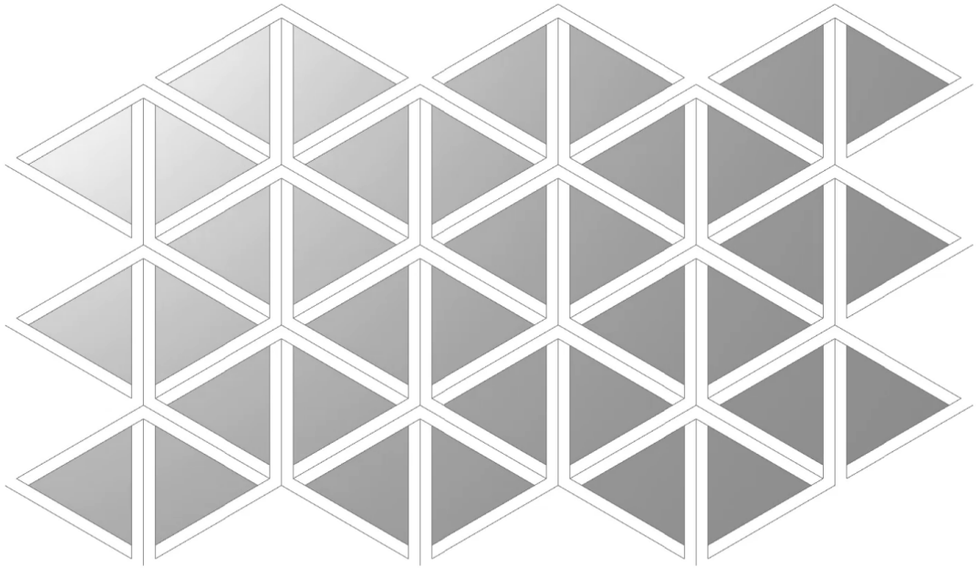
Muster 2



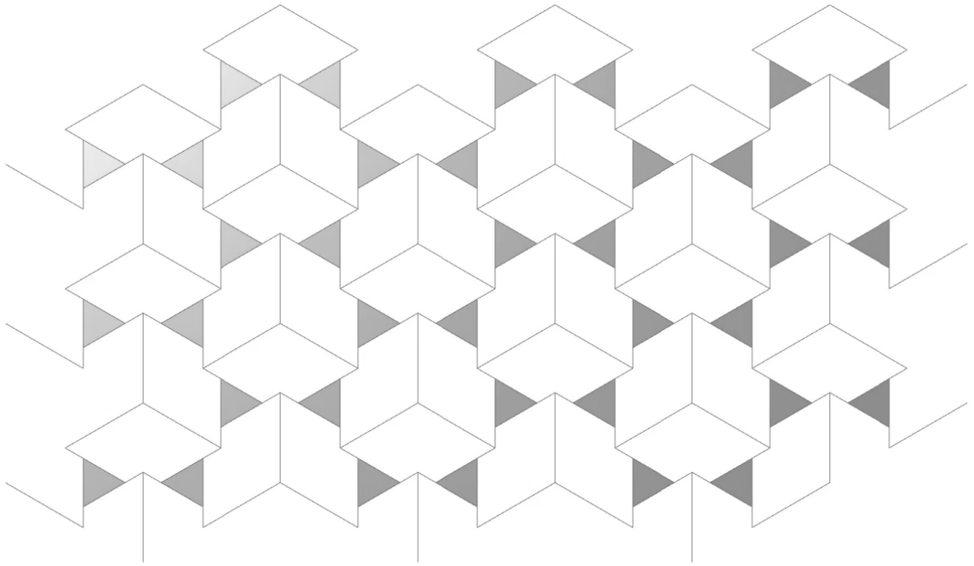
Muster Unendliche Varianten



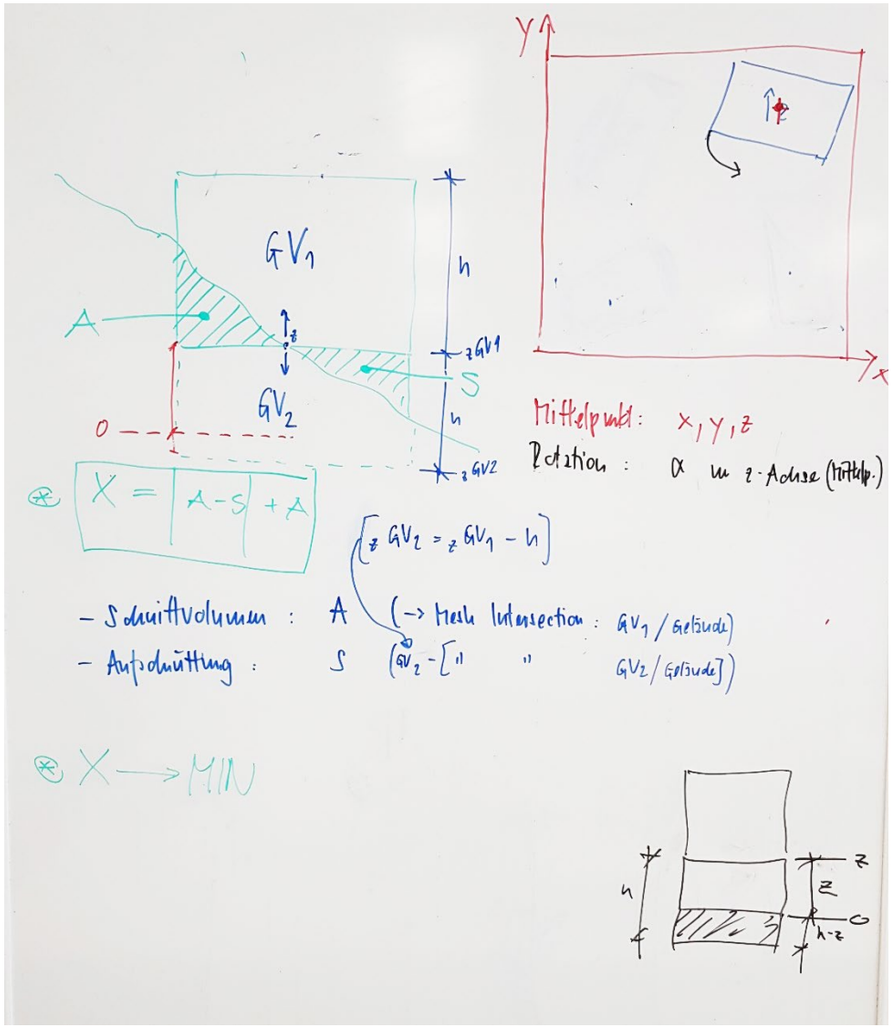
Muster 1

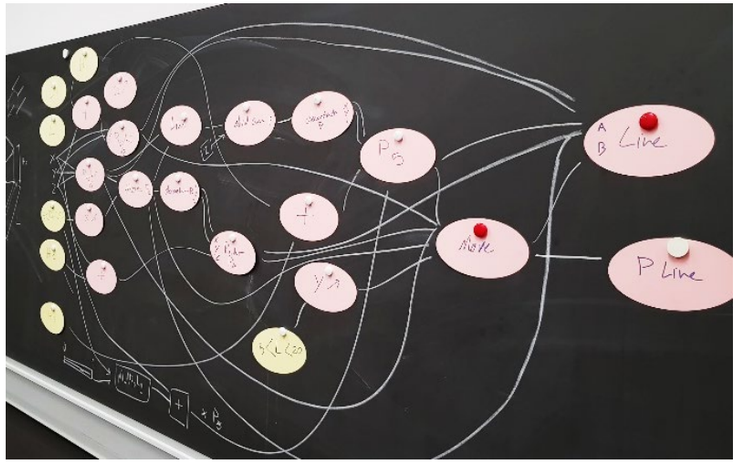


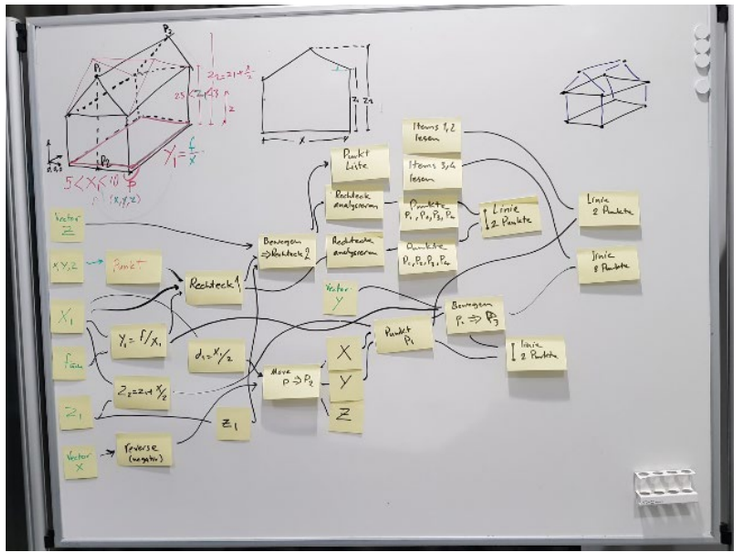
Muster 2

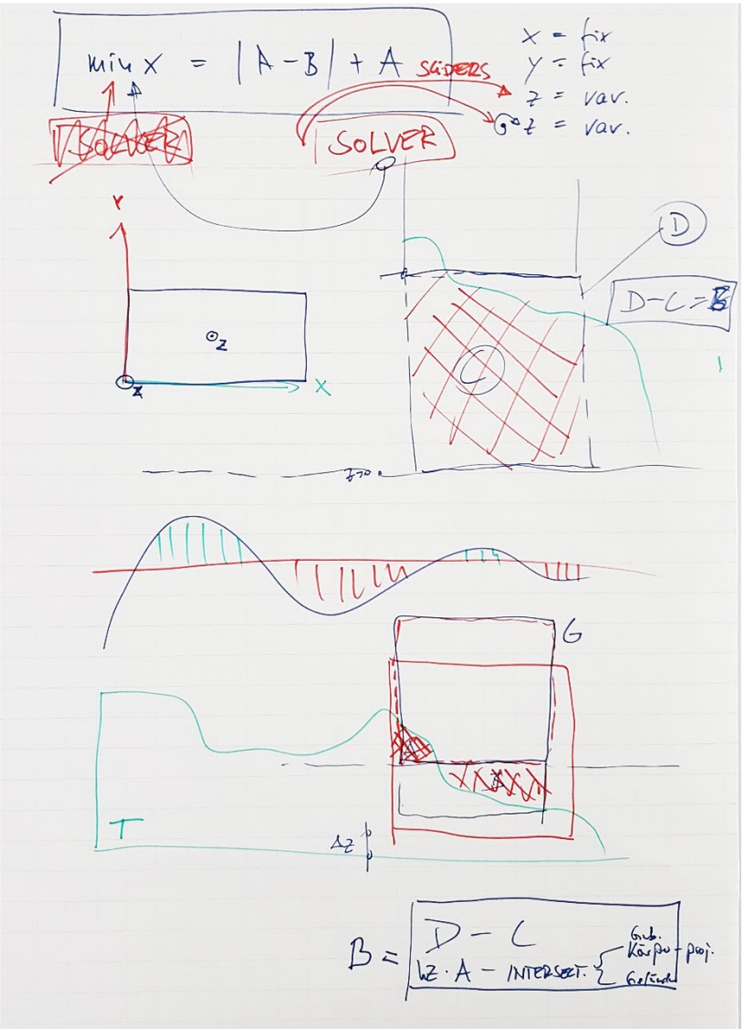


die Fähigkeit zur Abstraktion und Regeln zu extrahieren

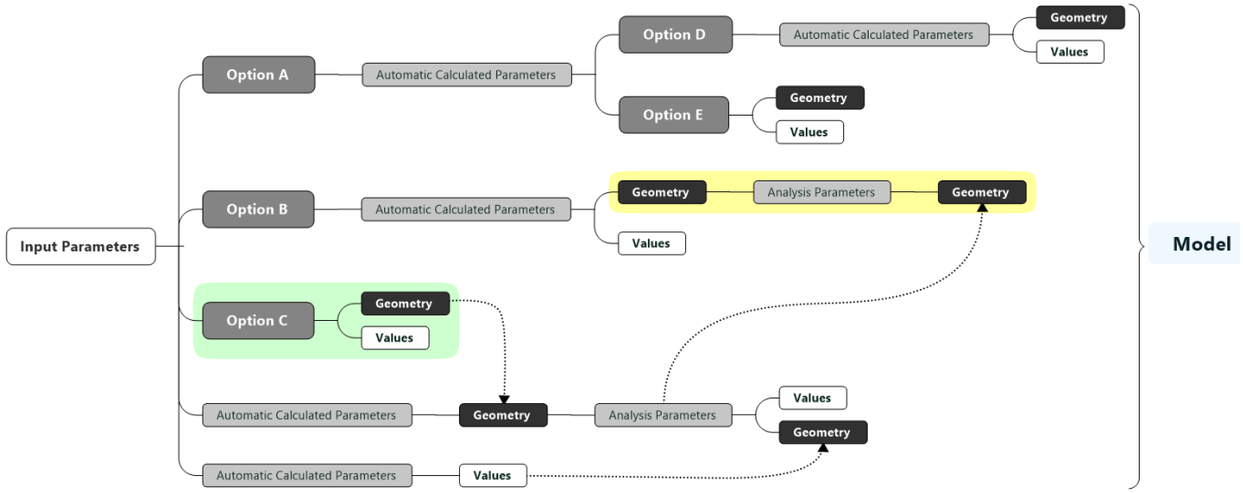

GV1
GV2
A
S
h
Mittelpunkt: x, y, z
Rotation: α um z-Achse (Mittelp.)
X = |A - S| + A
- Schnittvolumen: A (-> Mesh Intersection: GV1 / Gebäude)
- Aufschüttung: S (GV2 - [" " GV2 / Gebäude])
X -> MIN


Line
P Line

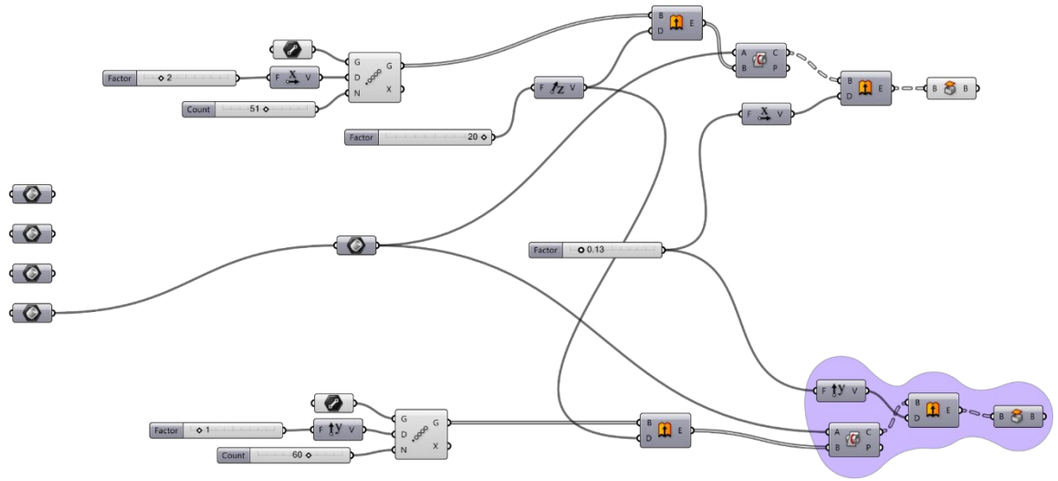



min X = |A - B| + A
SOLVER
x = fix
y = fix
z = var.
t = var.
D - C = B
G
T
B = D - C
INTERSECT.

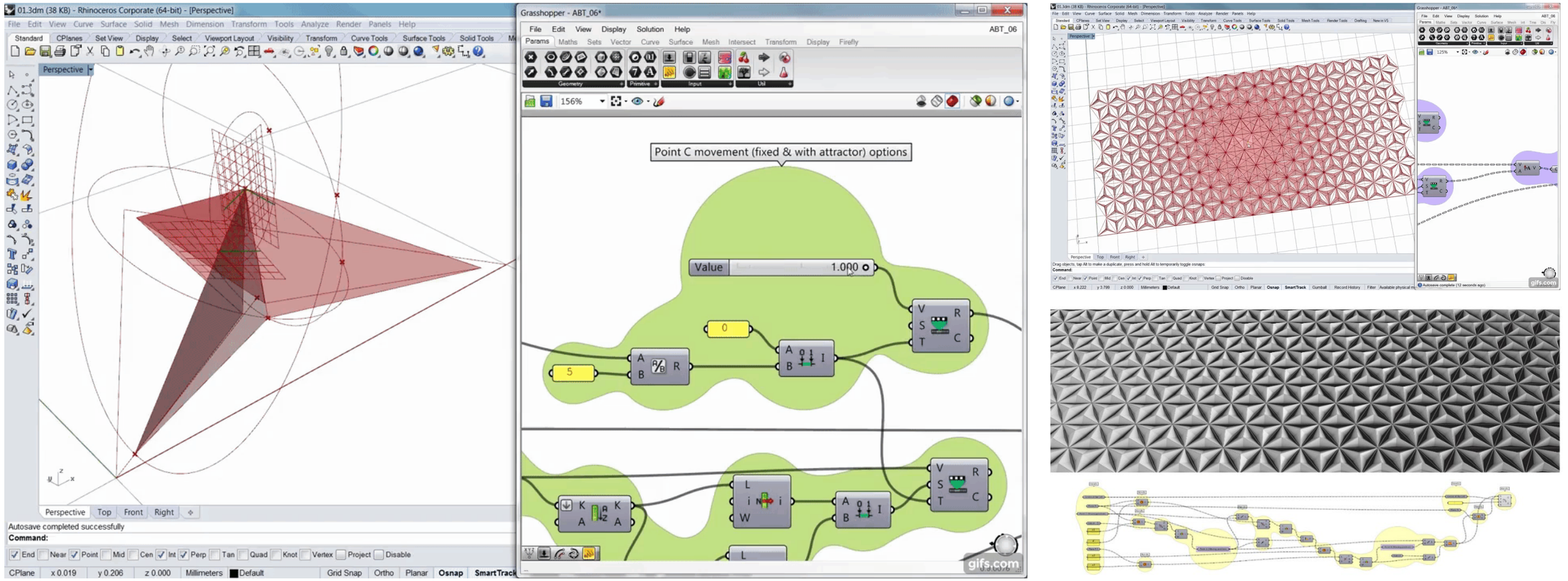
Logical Model



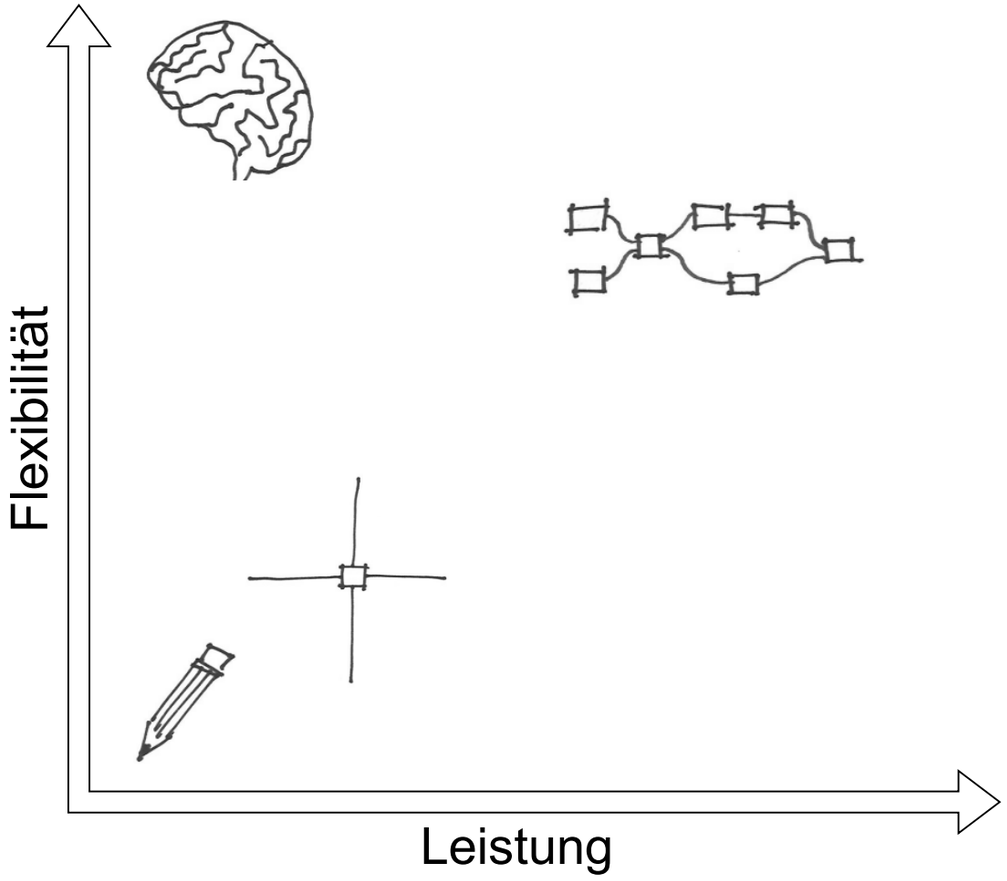
Code



Wir können komplexe Probleme lösen, indem wir mit Abstraktion denken.



Quelle: W.Wahbeh https://youtu.be/kIL8KrPKi24



Was wir uns vorstellen und was wir ausdrücken

Mentales Design Bild:

Flexibel, mehrere Lösungen, kleine Leistung

Ausdruck des Designs:

Handzeichnung:

Nicht Flexibel, ein Lösungen, geringer Aufwand

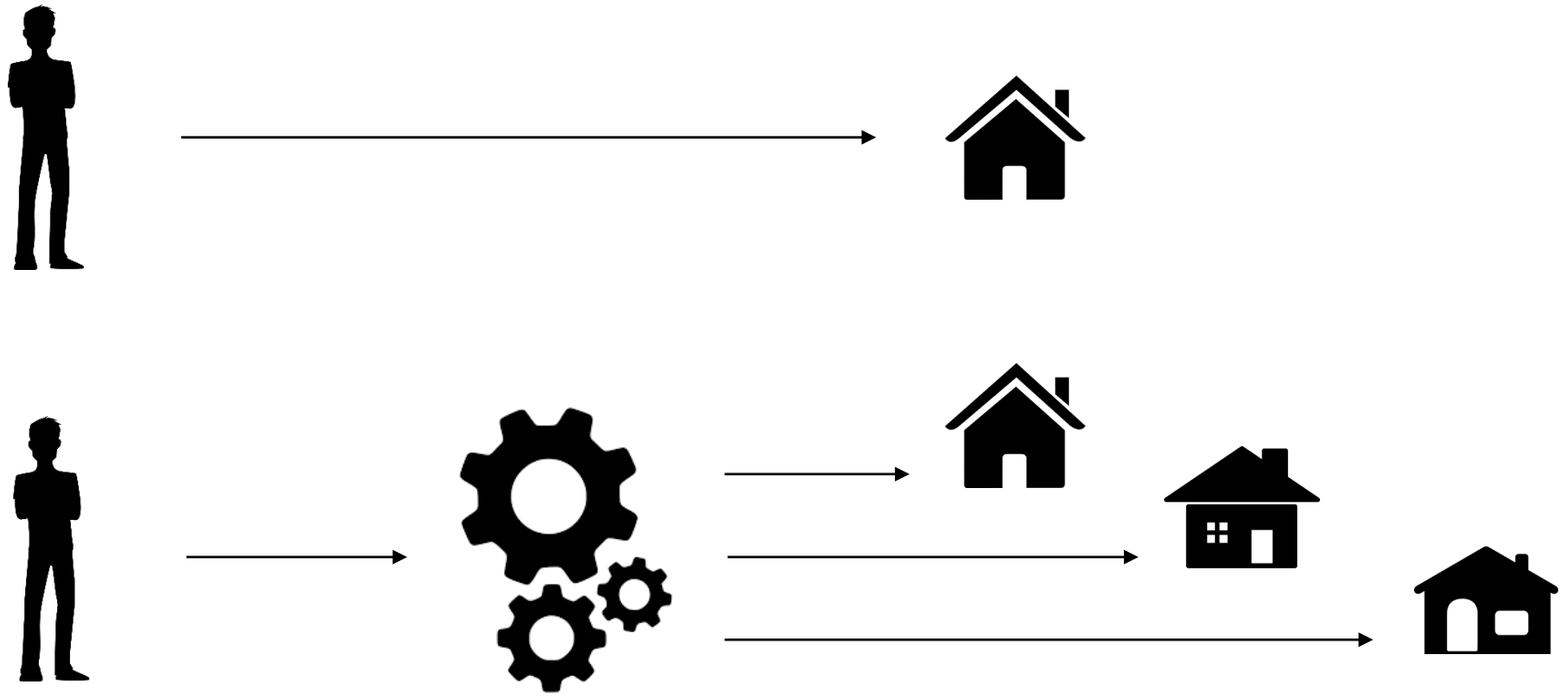
Digitale Zeichnung:

Nicht Flexibel aber leicht modifizierbar, ein Lösungen, mittlerer Aufwand

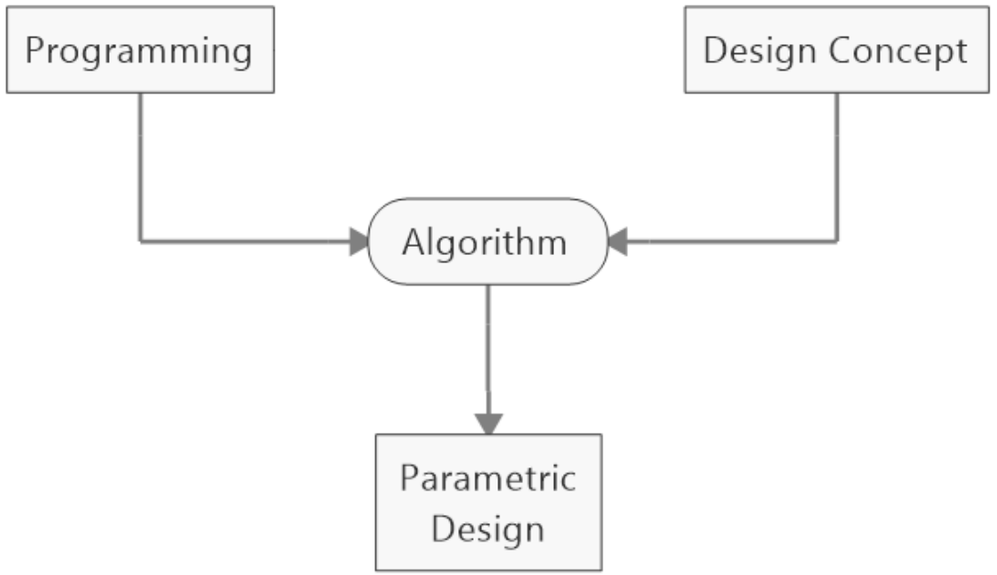
Parametrische Zeichnung:

Flexibel aber nicht leicht modifizierbar, mehrere Lösungen, Grosser Aufwand

Der parametrische Designprozess unterscheidet sich vom traditionellen Designansatz.
Im parametrischen Design **erstellt der Designer ein System und dieses System erstellt das Modell** auf Basis von Variablen. (Verschiedene Werte → Verschiedene Modelle)

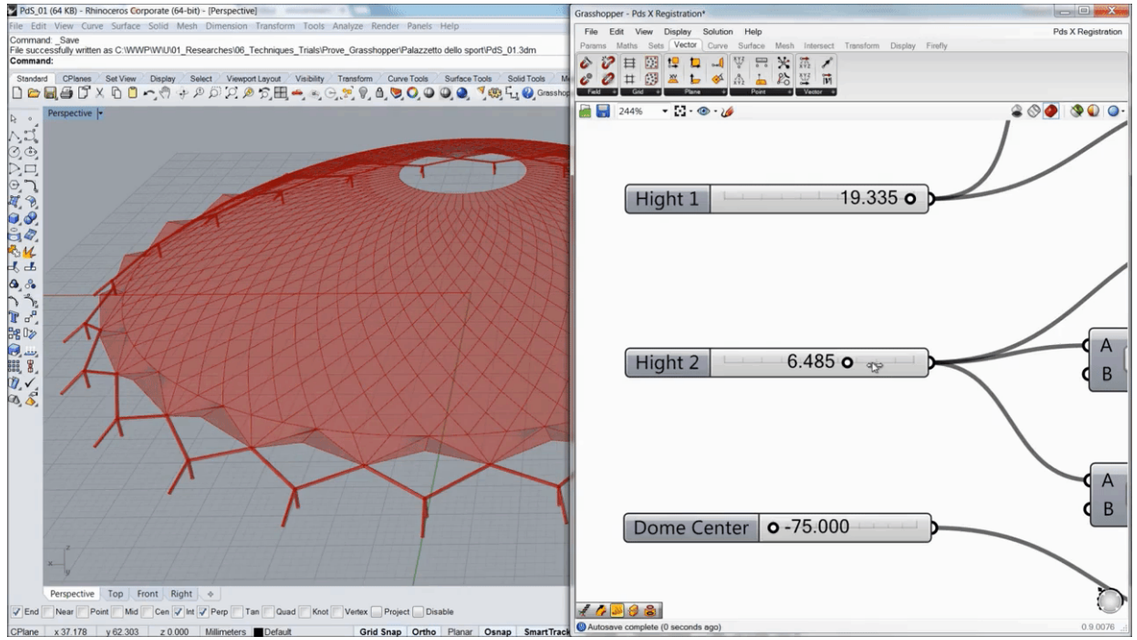


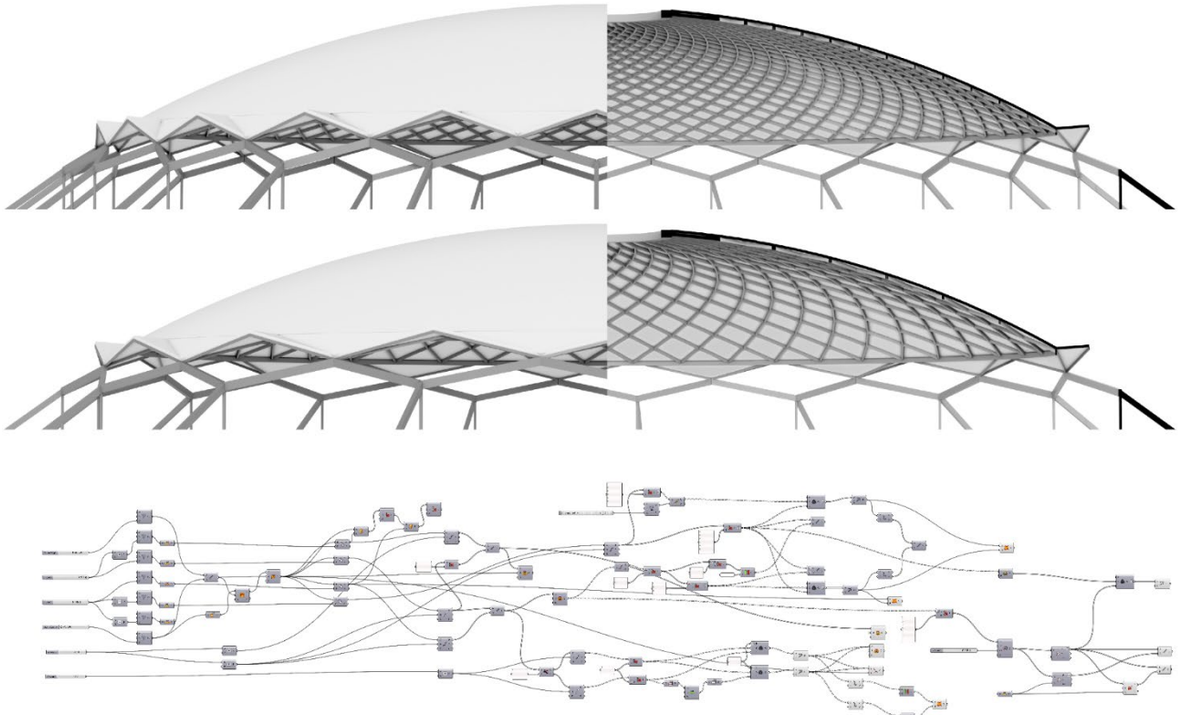
Parametric Design: Ein neuer Designansatz



Quelle: W.Wahbeh

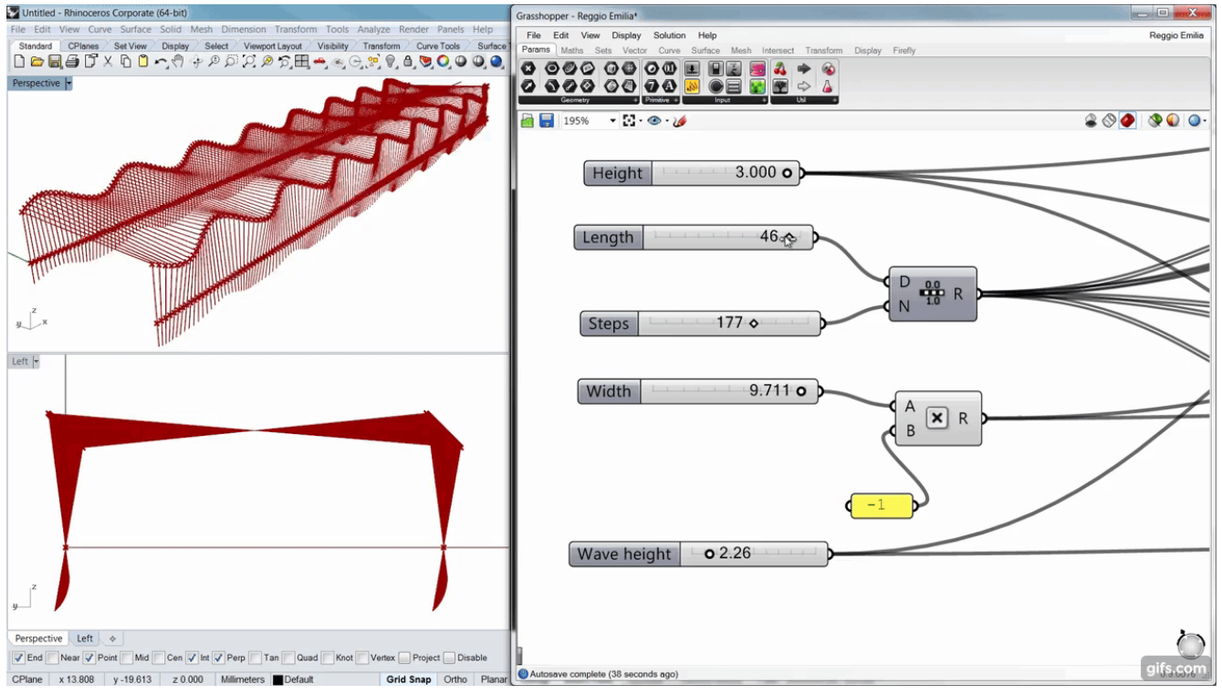
Complex Structures



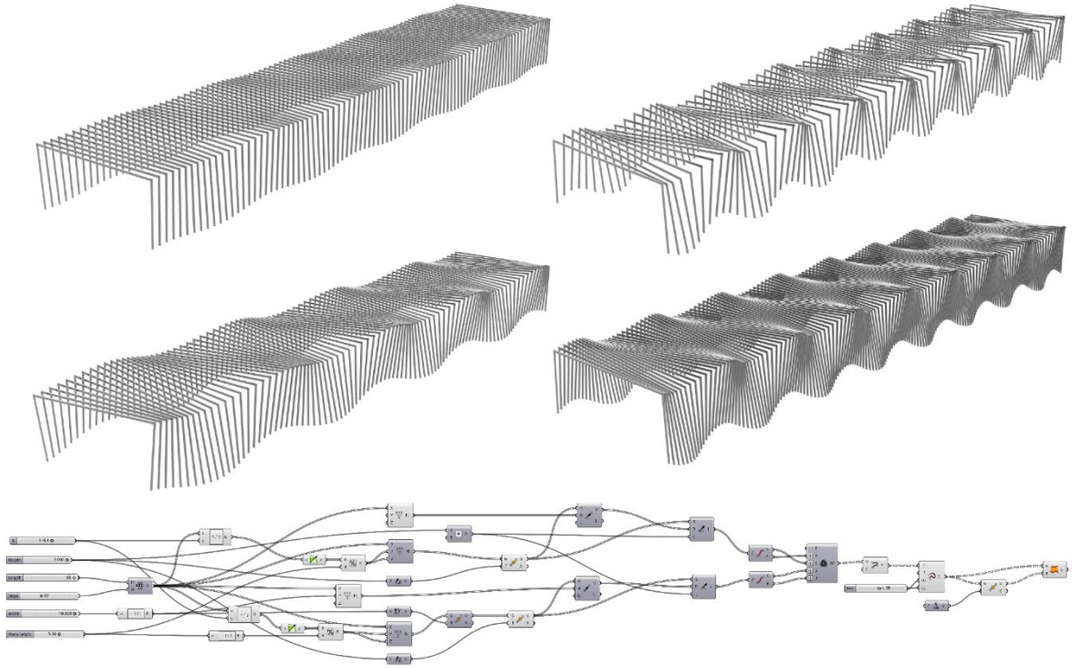


Quelle: W.Wahbeh

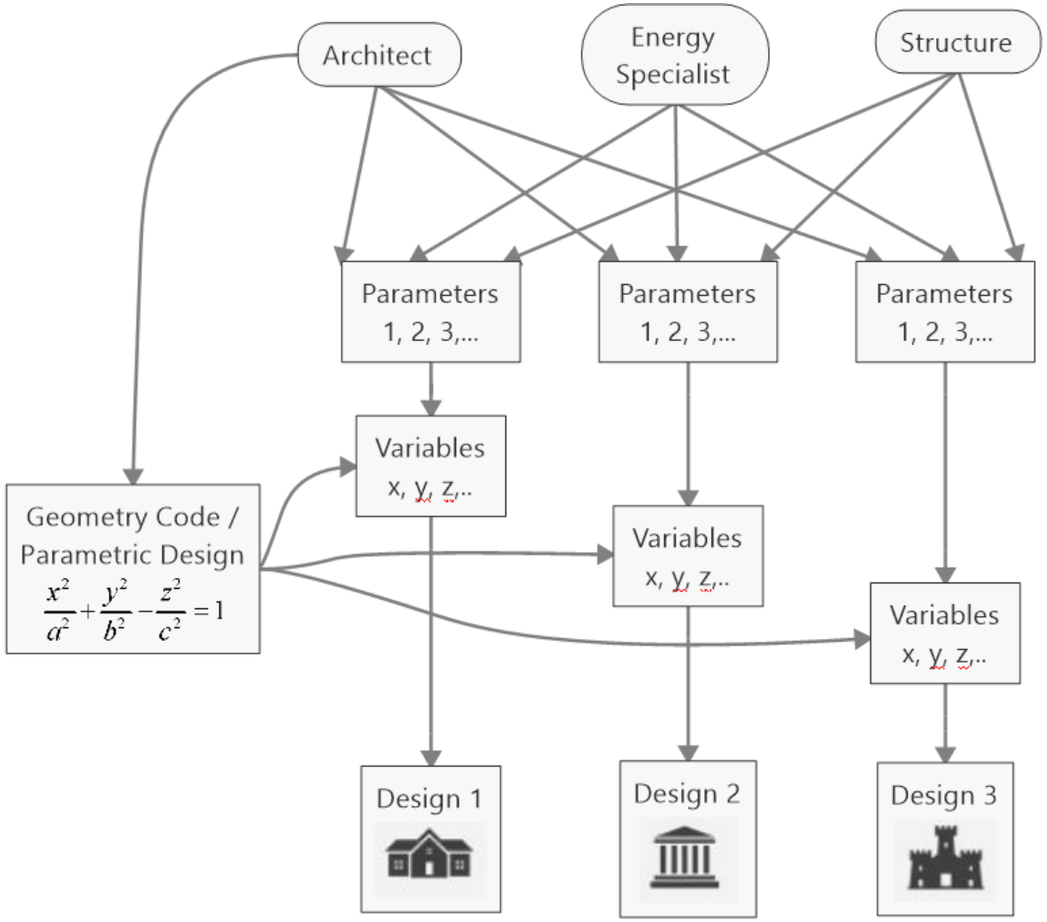
Mathematical Functions



Quelle: W.Wahbeh https://youtu.be/fi0TVO7X4ck



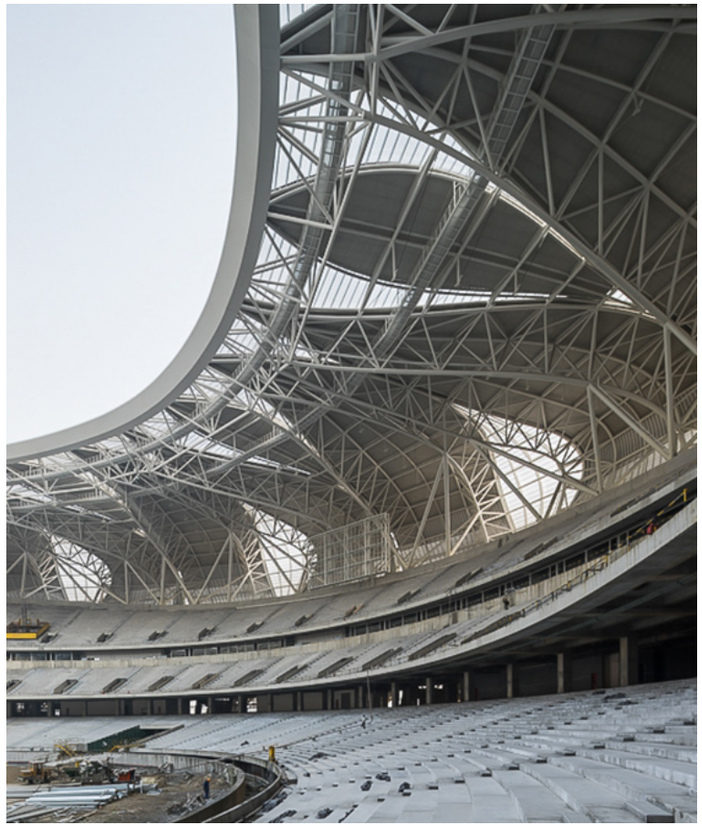
Quelle: W.Wahbeh



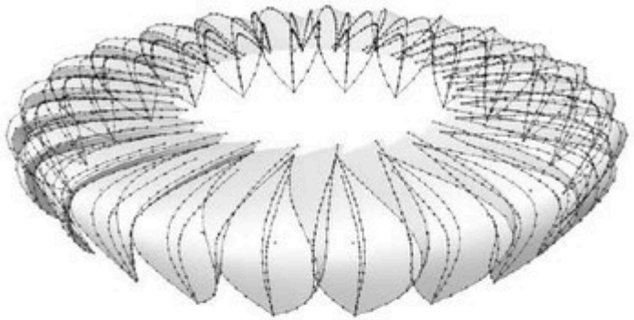
Interdisziplinärer Designansatz

Parametrisches Design kann auf mehr als eine Disziplin ausgedehnt werden, um ein interdisziplinäres Design zu erhalten.

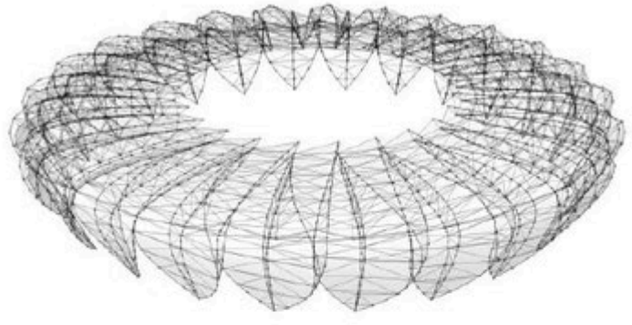
Complex structures: An interaction between Design and Structure



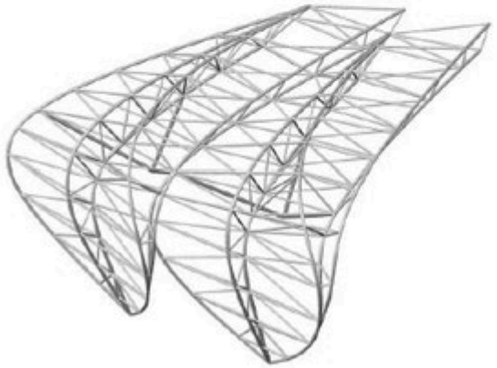
Hangzhou olympic sports center, Quelle: NBBJ + ACADIA



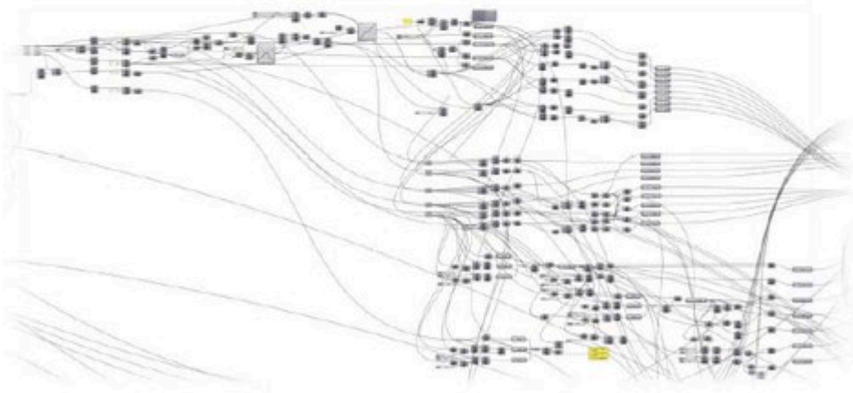
1. STRUCTURE NODES DEFINITION



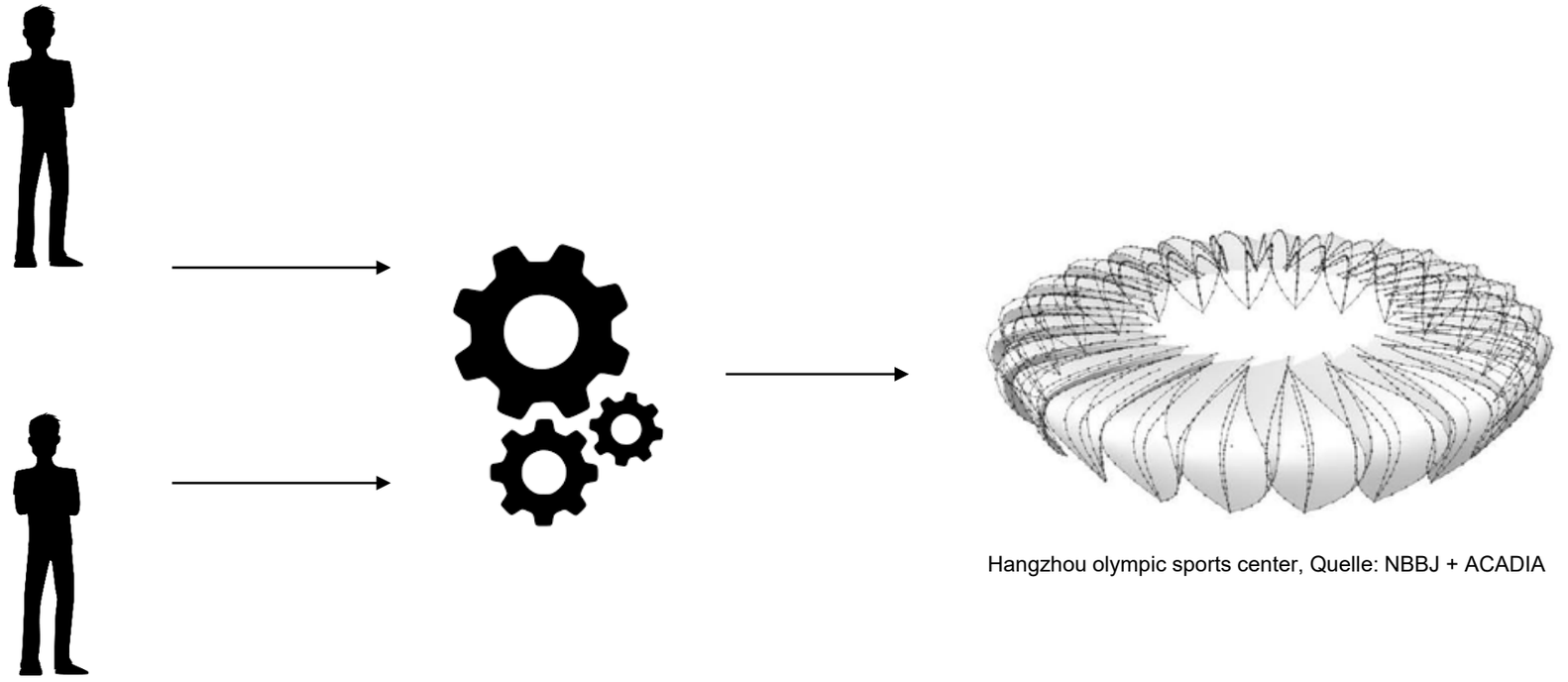
2. TRUSS CENTERLINE DEFINITION



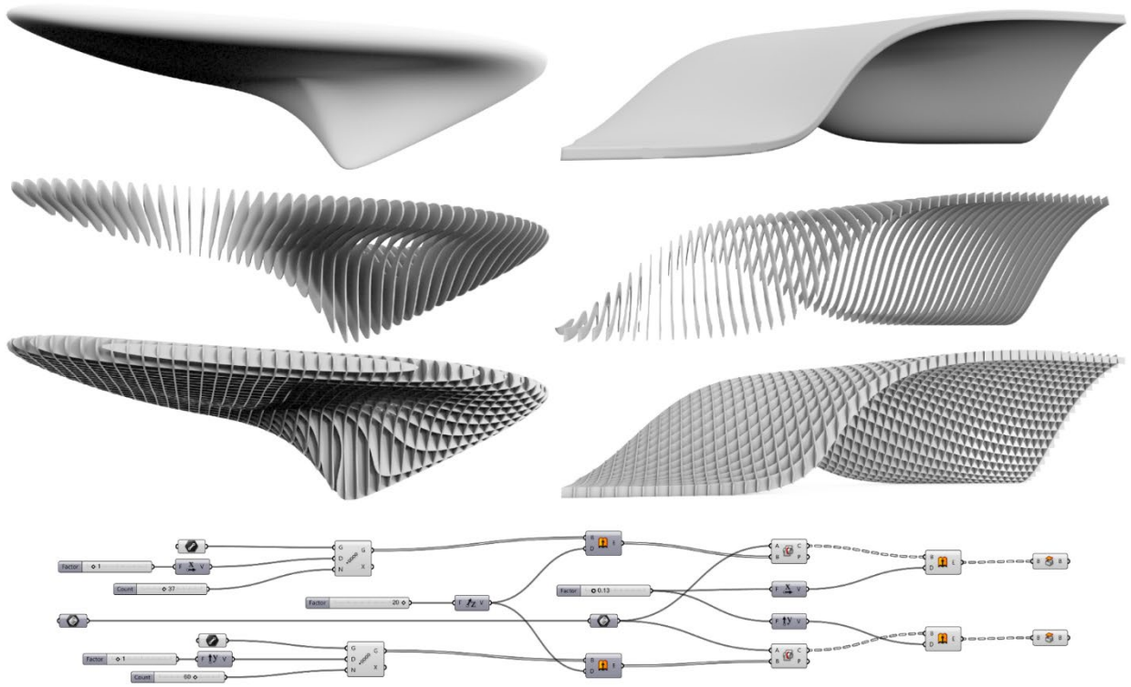
3. TRUSS MEMBER SIZE COORDINATION



Dieses System kann mehrere Eingaben des Designers (interdisziplinäres parametrisches Design), Berechnungsprozesse, Skripte und sogar künstliche Intelligenz beinhalten. Es kann sehr komplexe Ebenen erreichen.



Hangzhou olympic sports center, Quelle: NBBJ + ACADIA

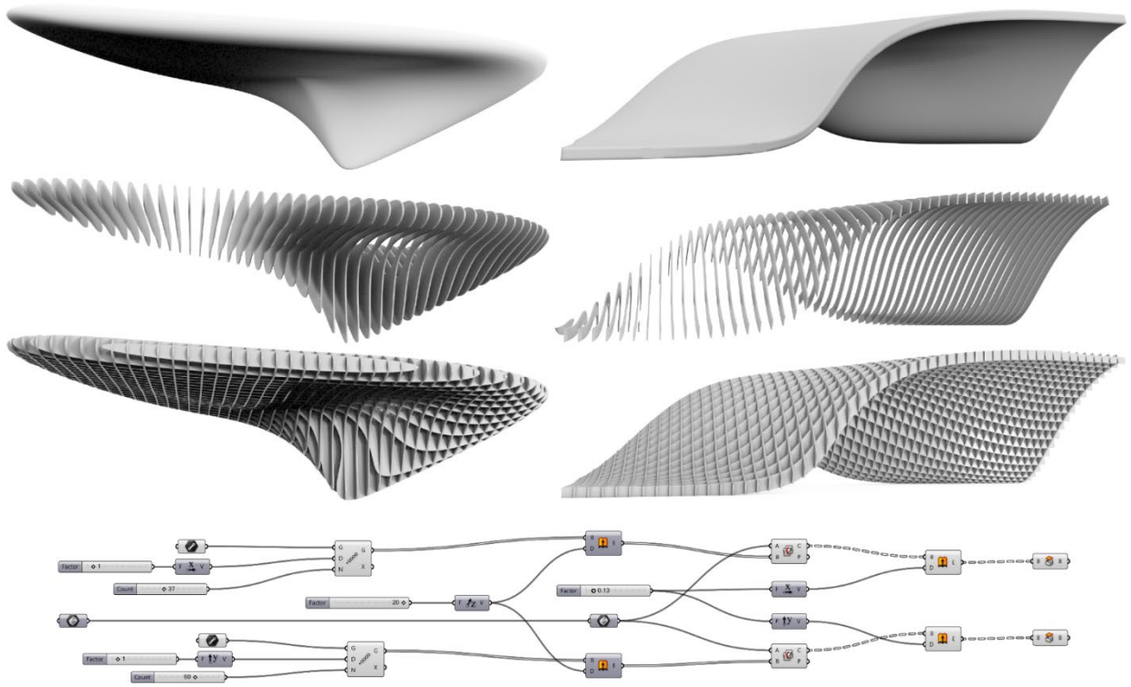


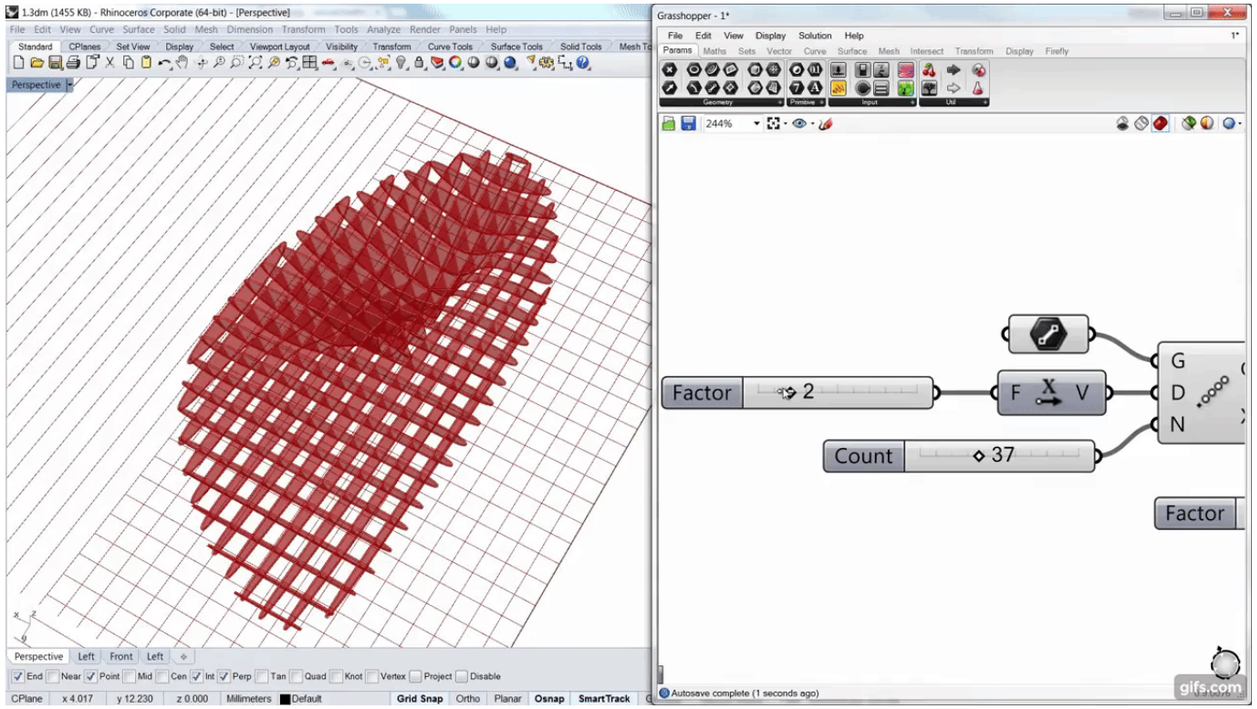
Quelle: W.Wahbeh

Routineaufgaben

Das Stichwort der Automatisierung führt zum Bereich des parametrischen Designs. Das parametrische Design entlastet Architekten von **Routineaufgaben** sowie unterstützt bei der Findung von neuen oder anderen architektonischen Lösungen. (Huber 2018)

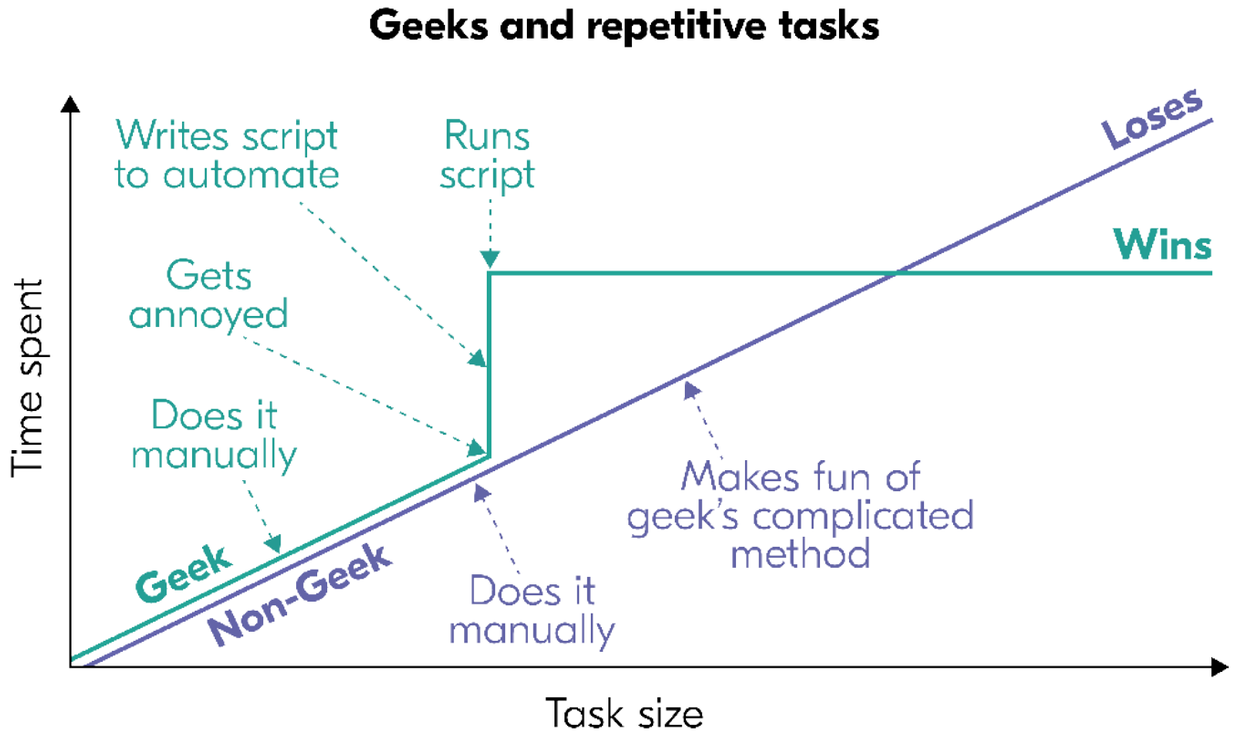
Routineaufgaben





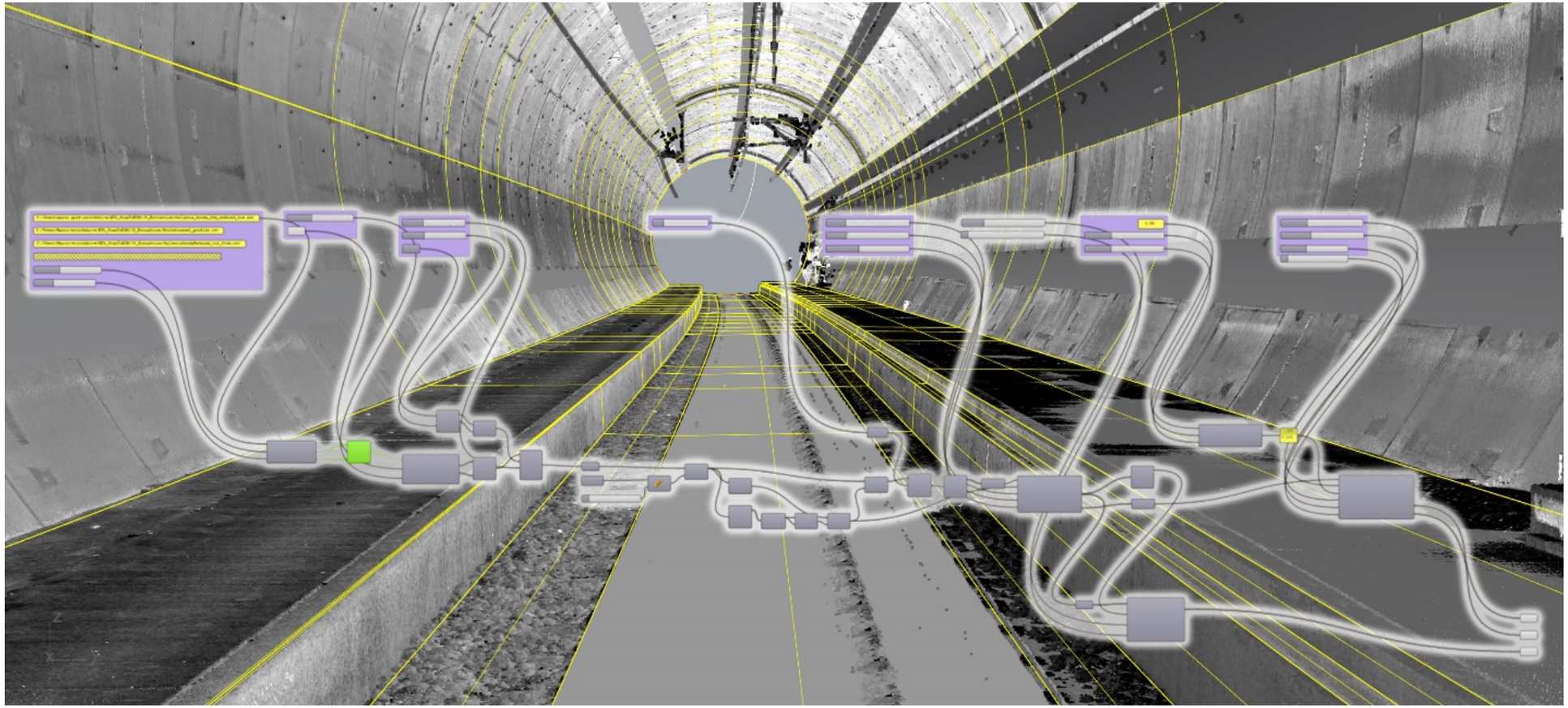
Quelle: W.Wahbeh https://youtu.be/apJaJ1TjNfQ

Wenn du den Geek-Modus ausprobierst, wirst du die Arbeitspferdementalität verlassen. Dein Slogan wird lauten: "Ich hätte das automatisieren sollen".



Source: pipedrive Blog

Source: Manuela Ammann, IGEO, FHNW



Quelle: Master thesis by M.Graf (FHNW Institut Geomatik)

Source: Manuela Ammann, IGEO, FHNW

Die DNA oder ein einzelnes Meisterwerk zu schaffen?

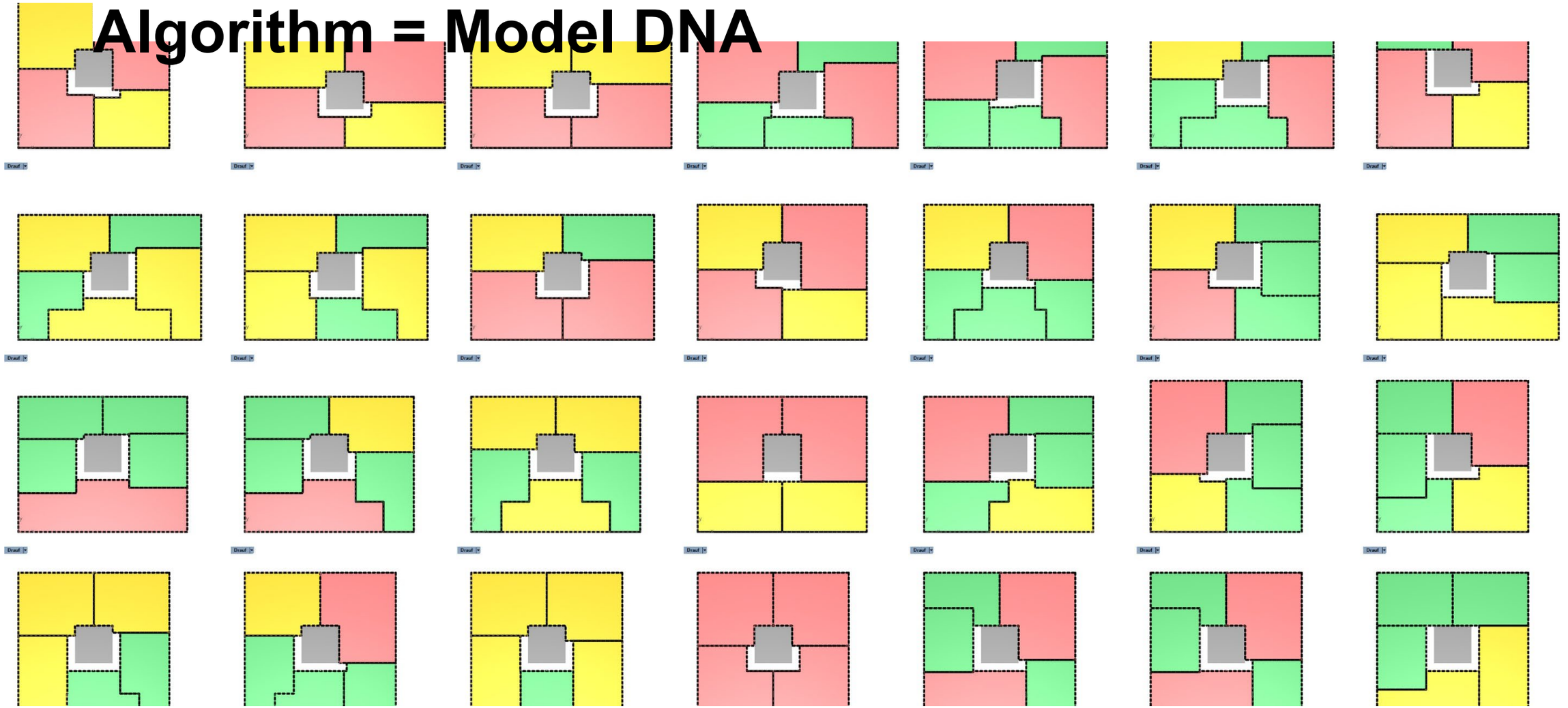
Quelle: https://texentes.com/asie/larmee-de-terre-cuite/

Quelle: Pixabay

Die DNA oder ein einzelnes Meisterwerk zu schaffen?

If we have the Algorithm of Terracotta soldier we can generate many different soldiers using different Parameters

Algorithm = Model DNA



Quelle: W.Wahbeh

Routineaufgaben

Shanghai Tower, Arch. Jun Xia Quelle: Wikipedia

Yas Hotel Abu Dhabi, Arch. Asymptote Architecture Quelle: ArchDaily

Unterstützung der Kreativität durch Generative Design

Parametricism als Architekturstil

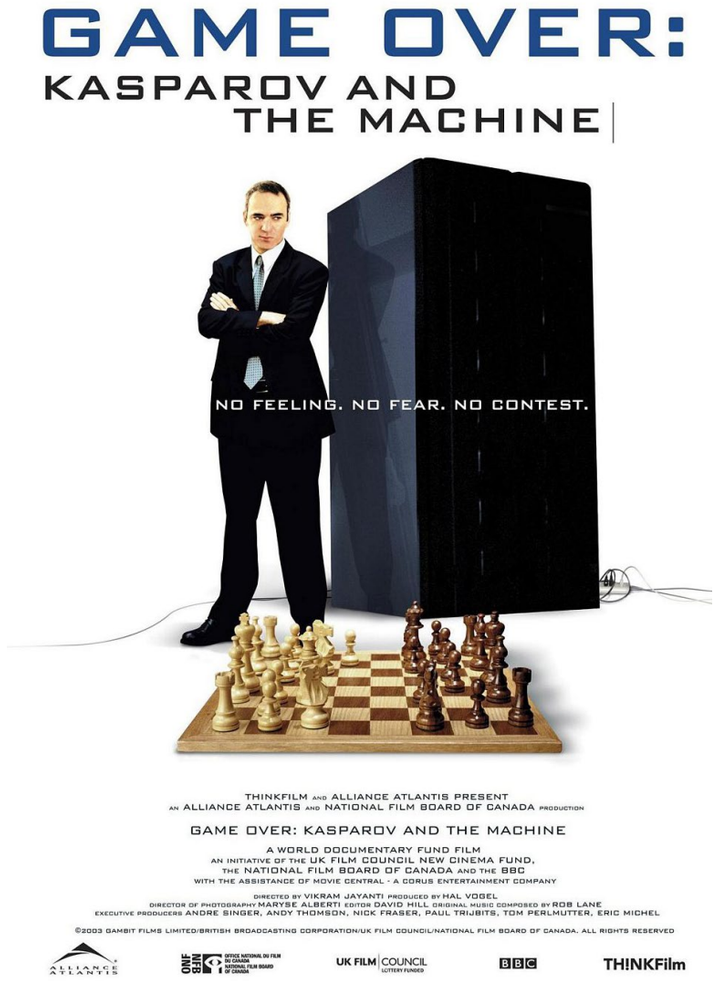
“Contemporary avant-garde architecture is addressing the demand for an increased level of articulated complexity by means of retooling its methods on the basis of parametric design systems. The contemporary architectural style that has achieved pervasive hegemony within the contemporary architectural avant-garde can be best understood as a research programme based upon the parametric paradigma. We propose to call this style: ***Parametricism***.”

Patrik Schumacher, London 2008

Presented and discussed at the Dark Side Club1 ,

11th Architecture Biennale, Venice 2008

Quelle: Patrickschumacher.com

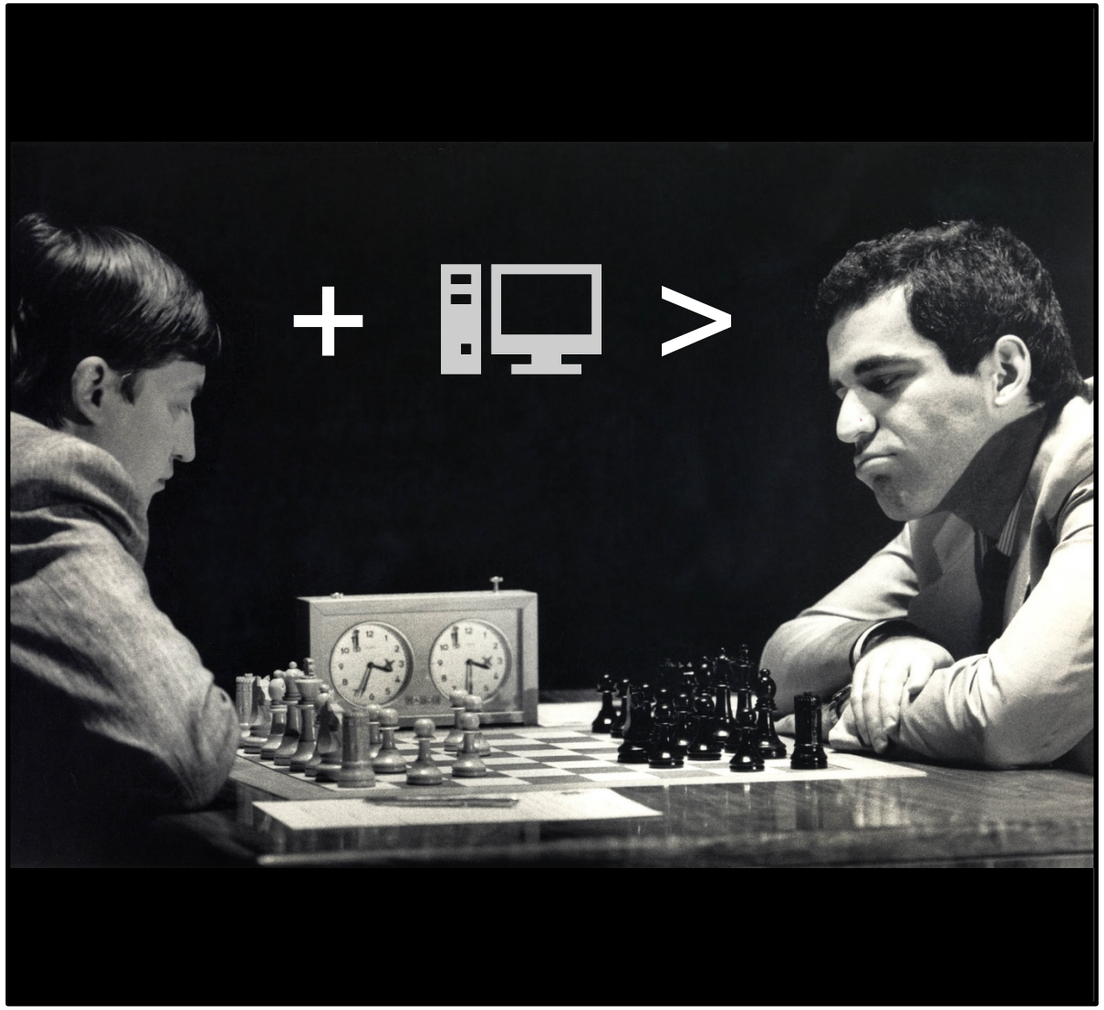


The Human Mind or the Machine Algorithm?

May 11, 1997: held in New York City, New York

Result: Deep Blue – Kasparov (3½ – 2½)

Deep Blue was the first computer program to defeat a world champion in a match under tournament regulations.



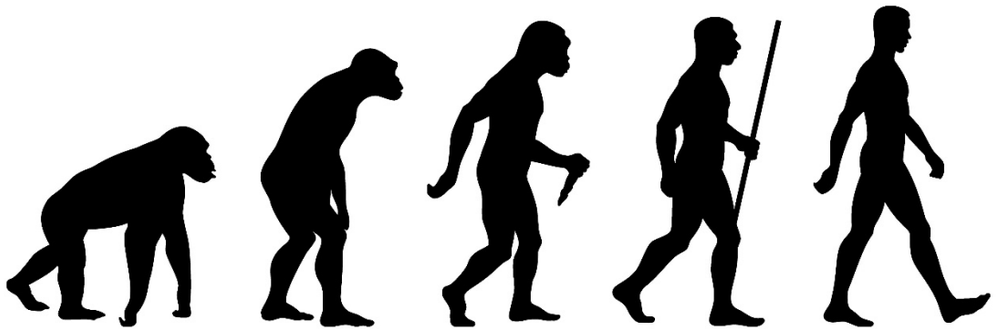
http://www.kasparov.com (edited)

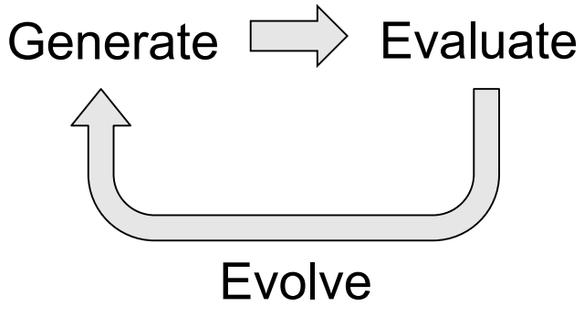
The Human Mind or the Machine Algorithm?
Or both together?

May 3. 1997 game 1 of 6, Deep Blue's **44th move** in this game puzzled Kasparov, and he attributed it to "**superior intelligence**“

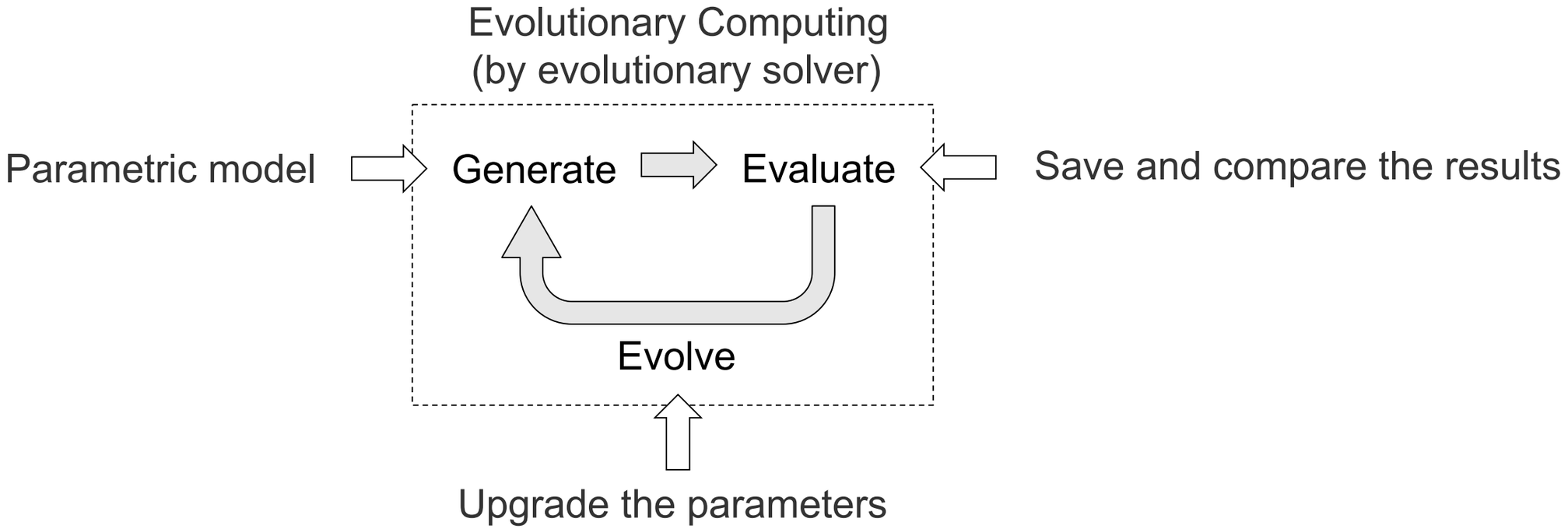
In May 4. 1997 in the game 2 of 6 Kasparov accused IBM of cheating, by alleging that a grandmaster (**presumably a top rival**) had been behind a move.

Generative Design

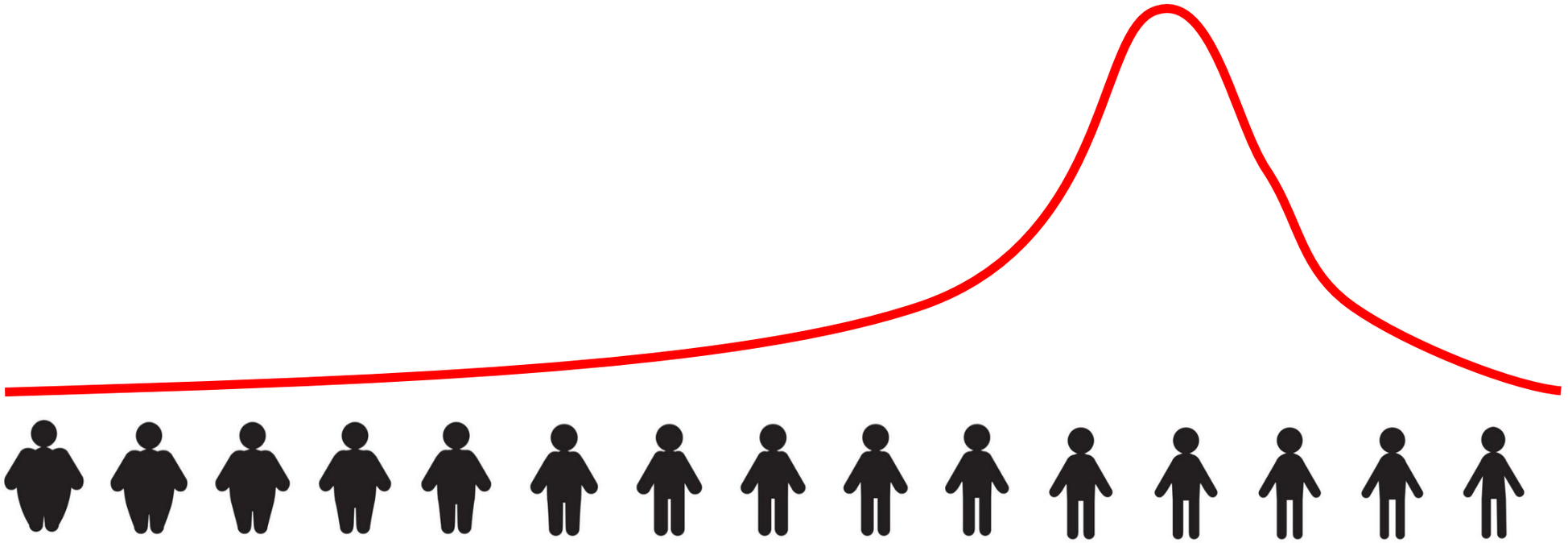




Wenn das System in der Lage ist, Lösungen zu bevorzugen oder Entscheidungen zu treffen, dann kann es das Design innerhalb vordefinierter Bereiche und der von uns festgelegten Grenzen weiterentwickeln. Dann nennen wir es **Generative Design**.

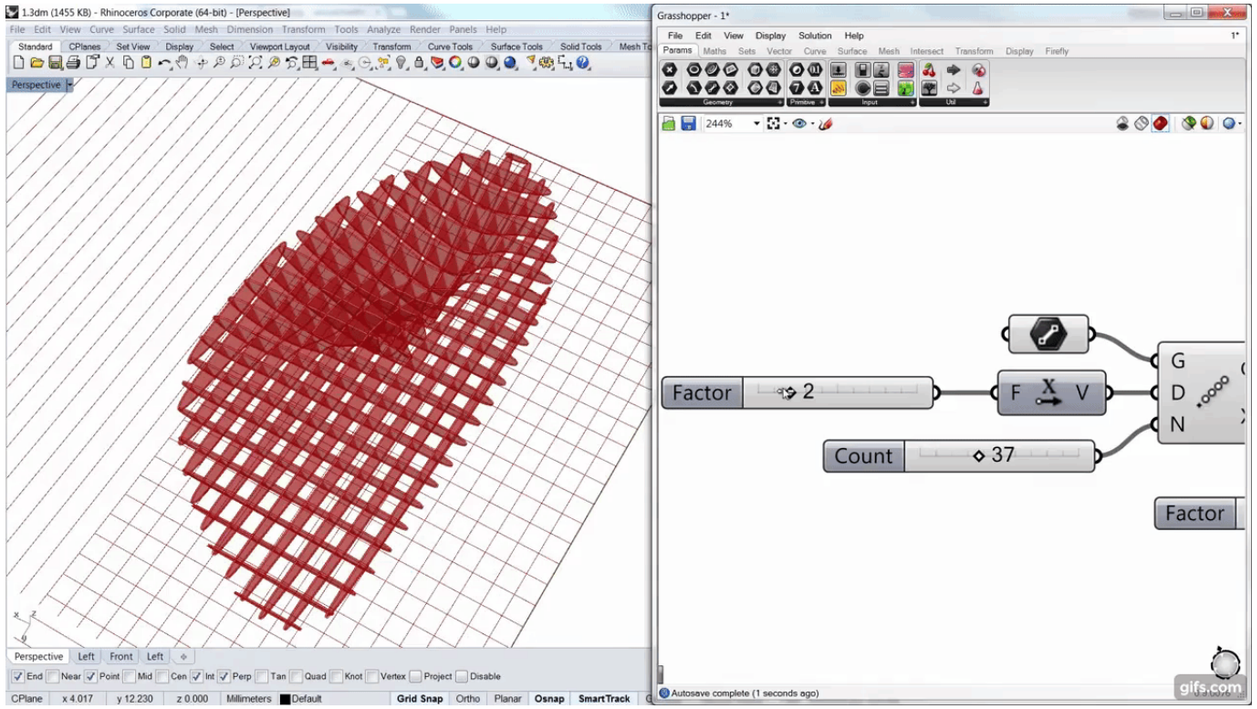

Evolutionary Computing
(by evolutionary solver)
Parametric model
Generate
Evaluate
Save and compare the results
Evolve
Upgrade the parameters

Fitness Funktion (Ziel Vorgabe)

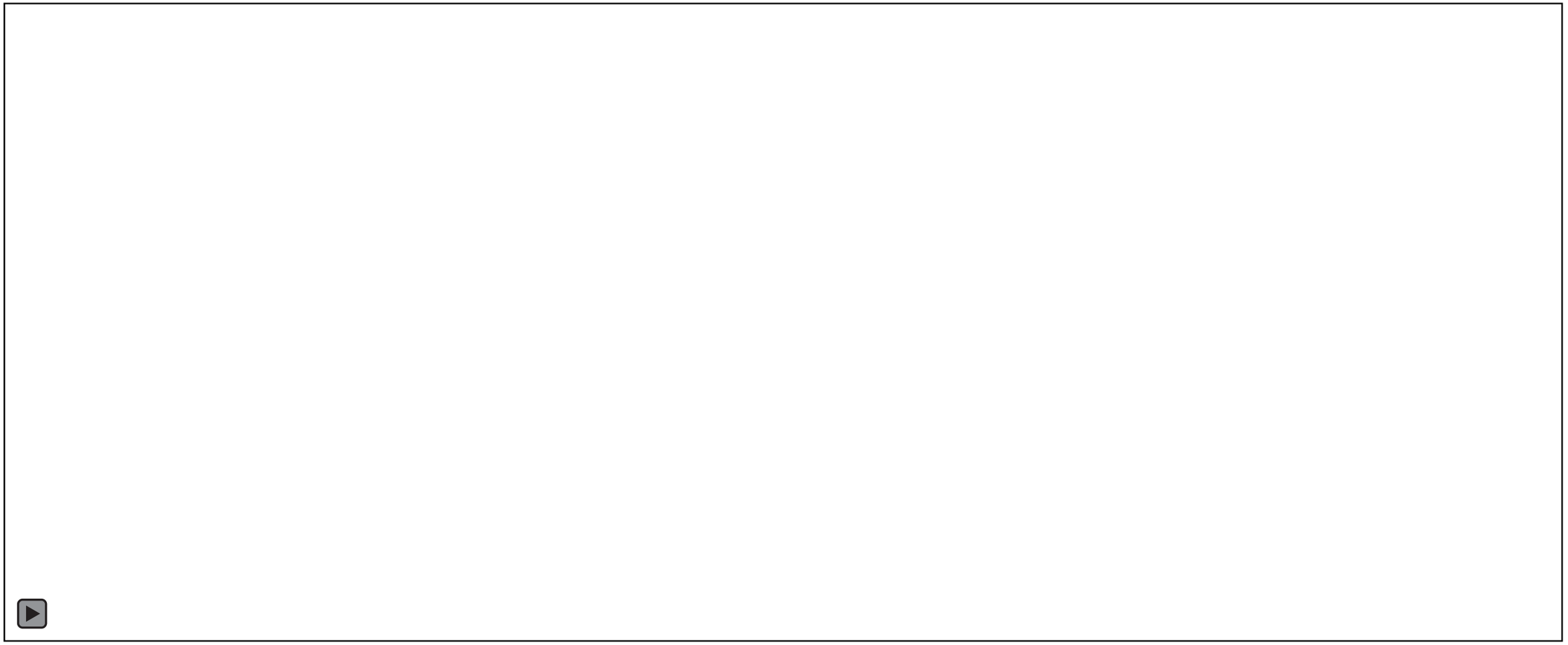


Source: Vectorstock.com (modified)

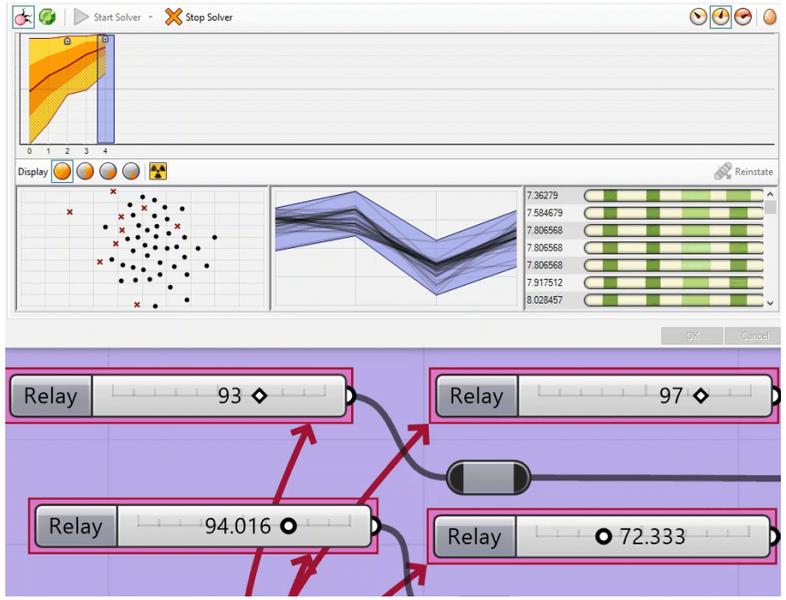
Fitness Funktion Beispiel

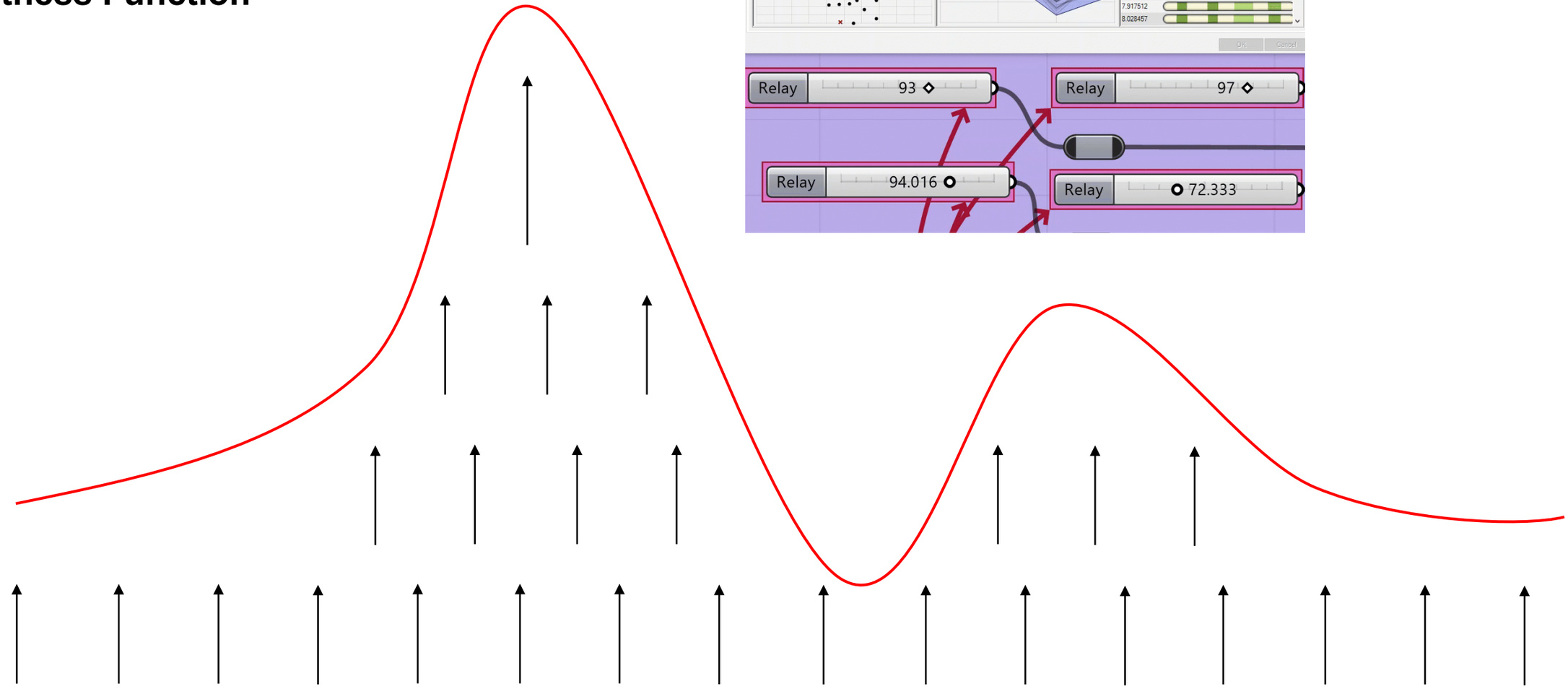


Placing a Building minimizing excavating and filling (*Aushub und Aufschüttung minimieren*)



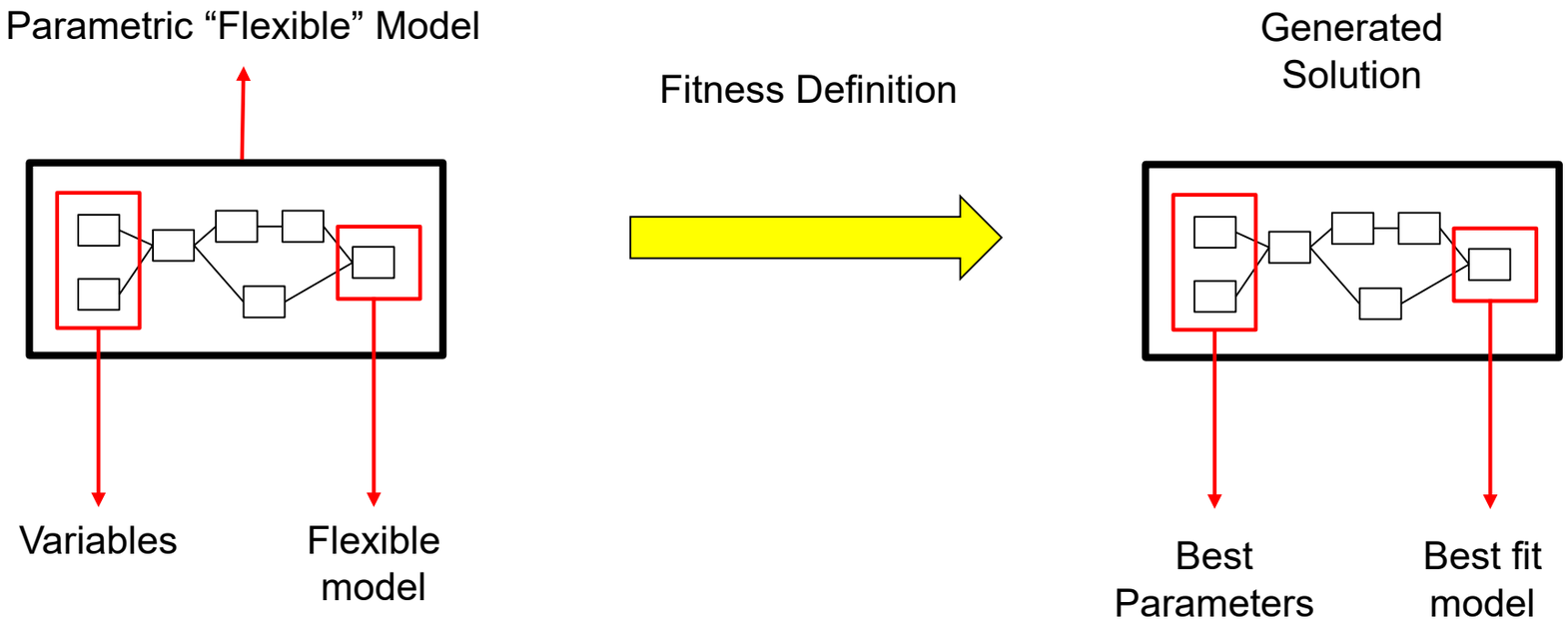
Fitness Function



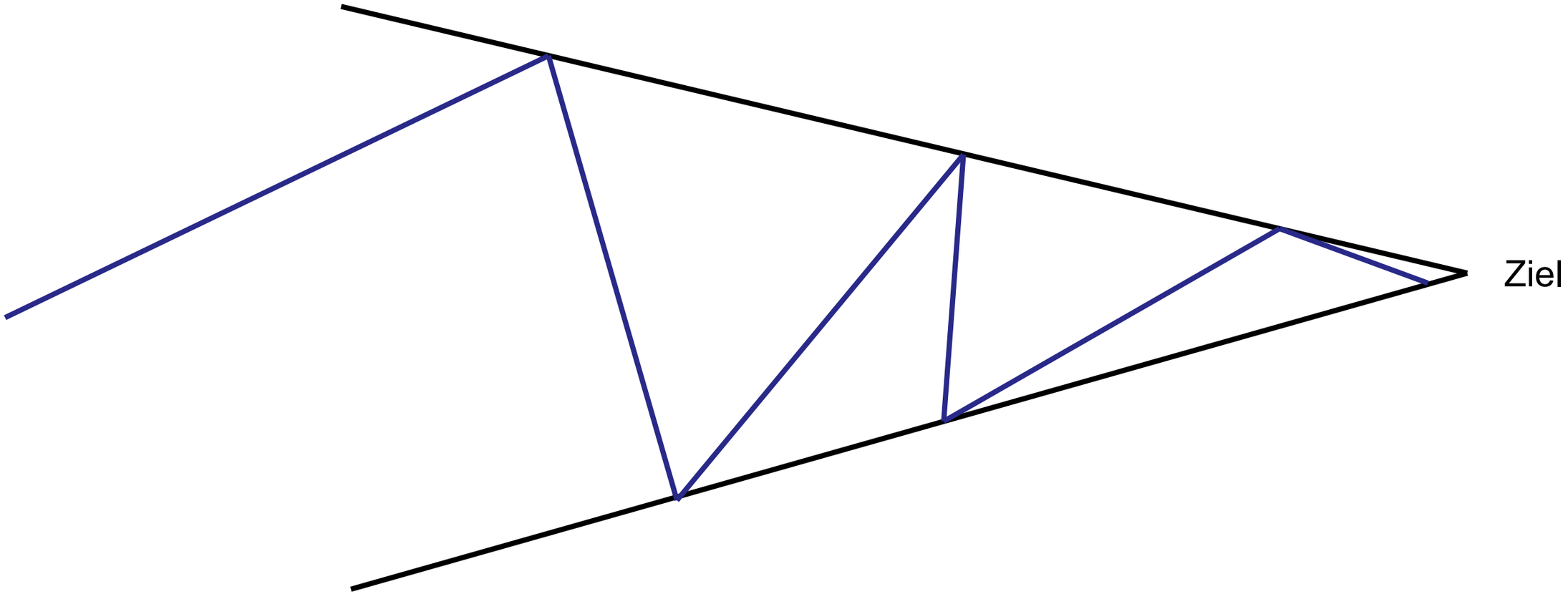


Generative Design

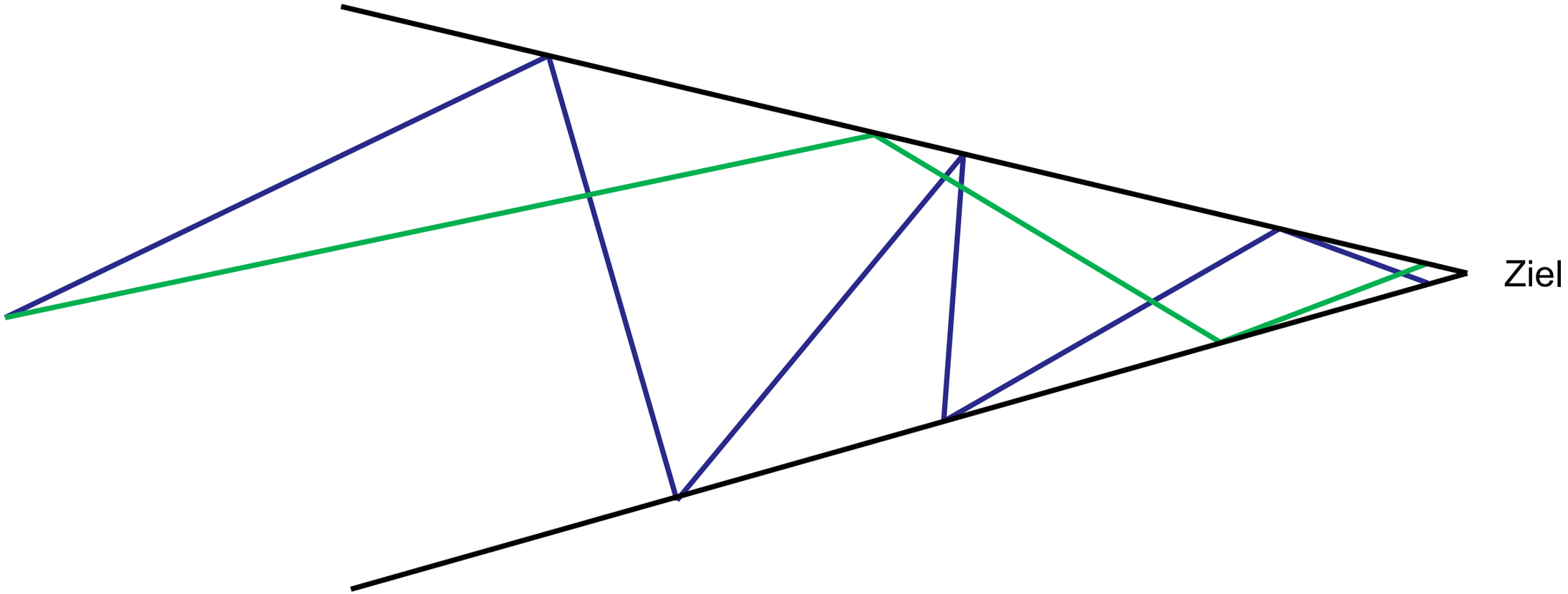
Form making → Form finding



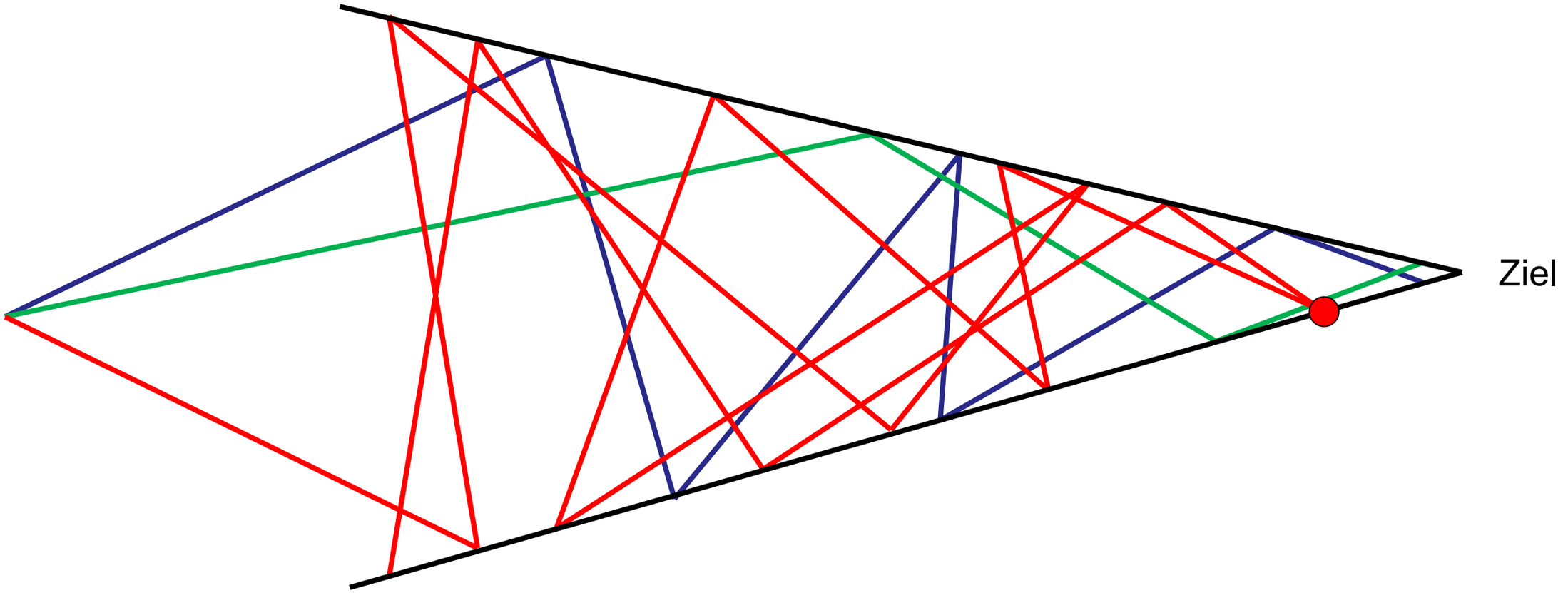
Von Grob zu fein



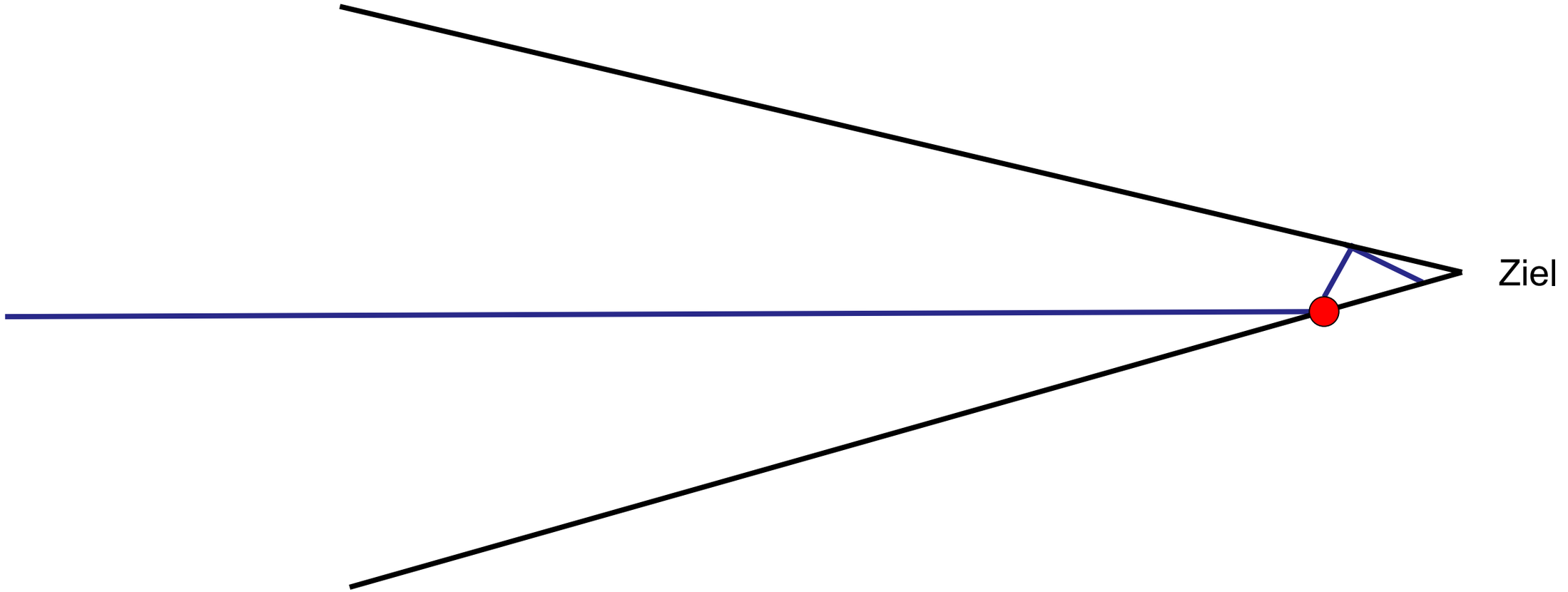
Von Grob zu fein



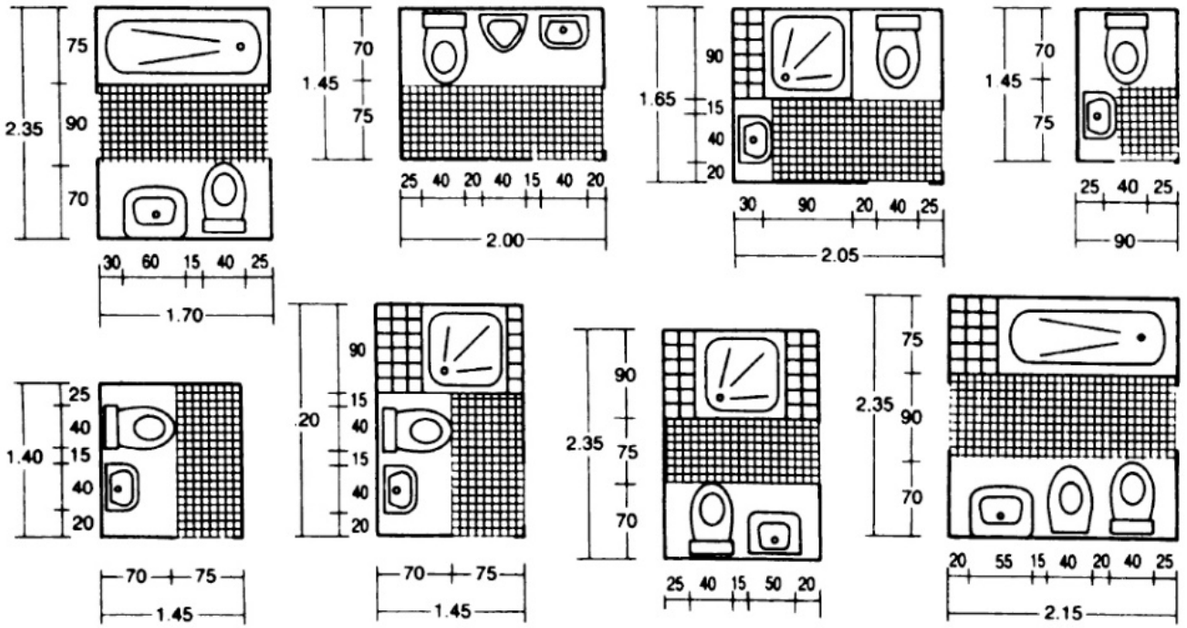
Von Grob zu fein



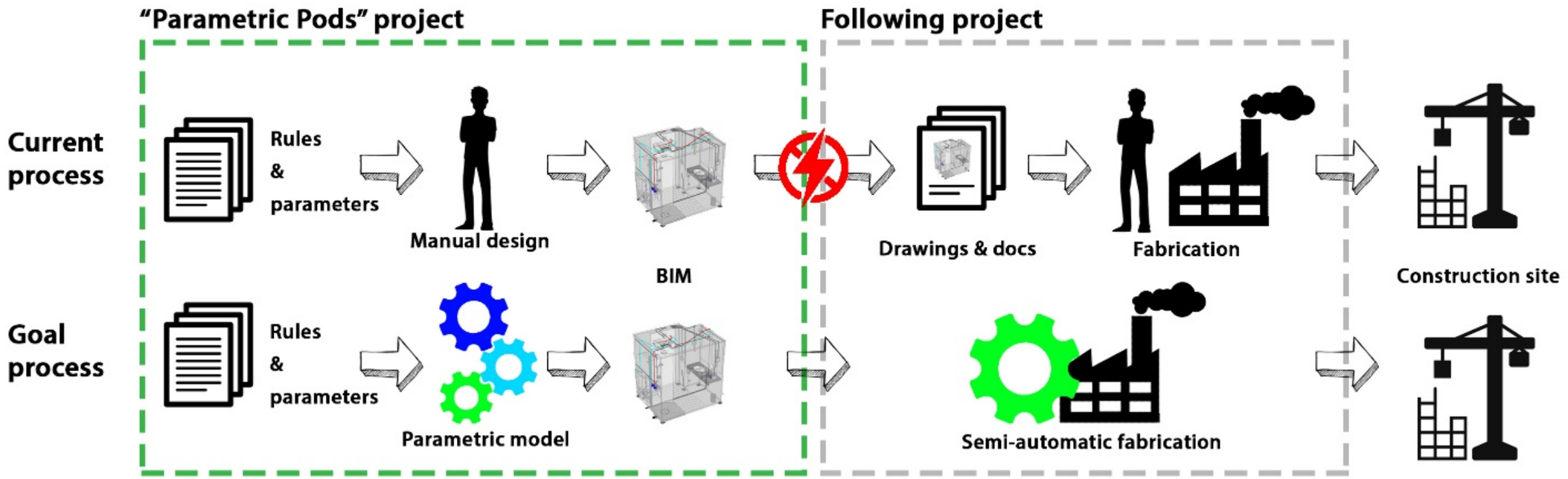
Von Grob zu fein



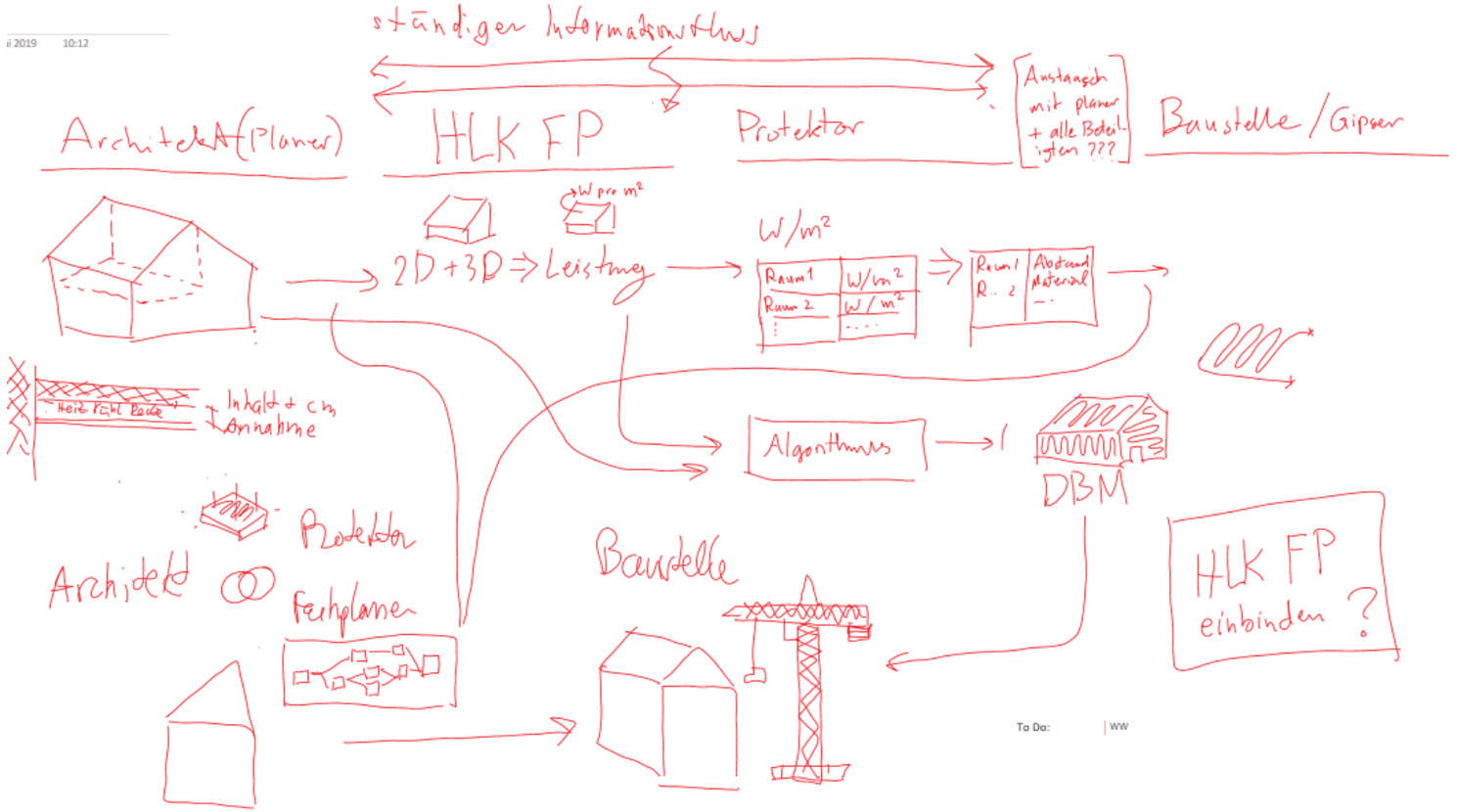
Parametric Pods: Forschung Projekt

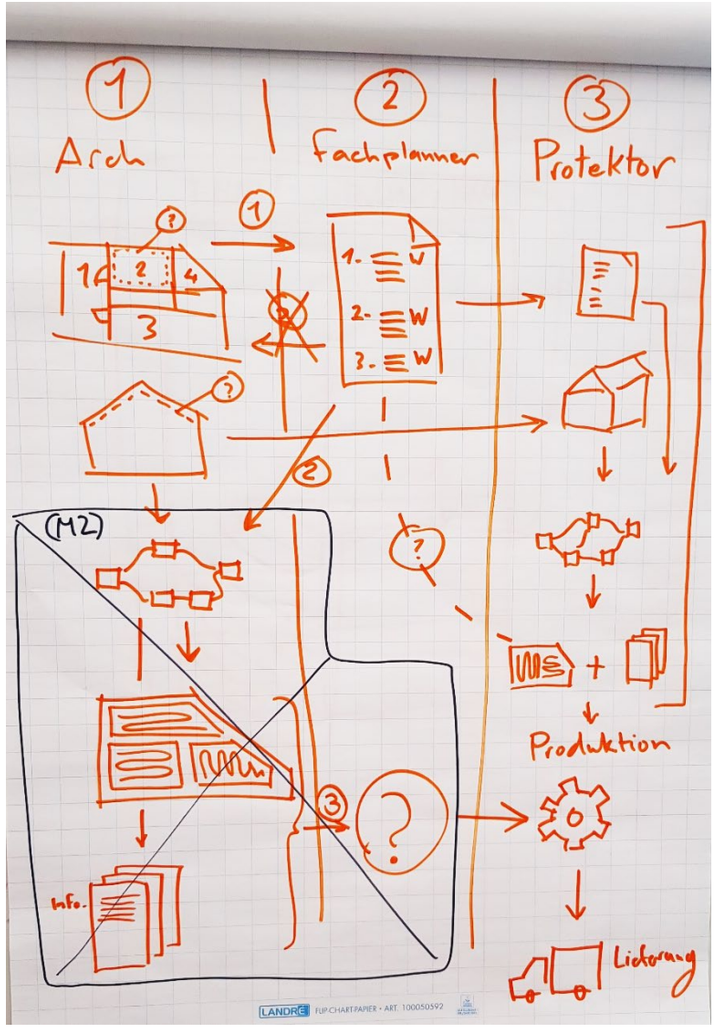


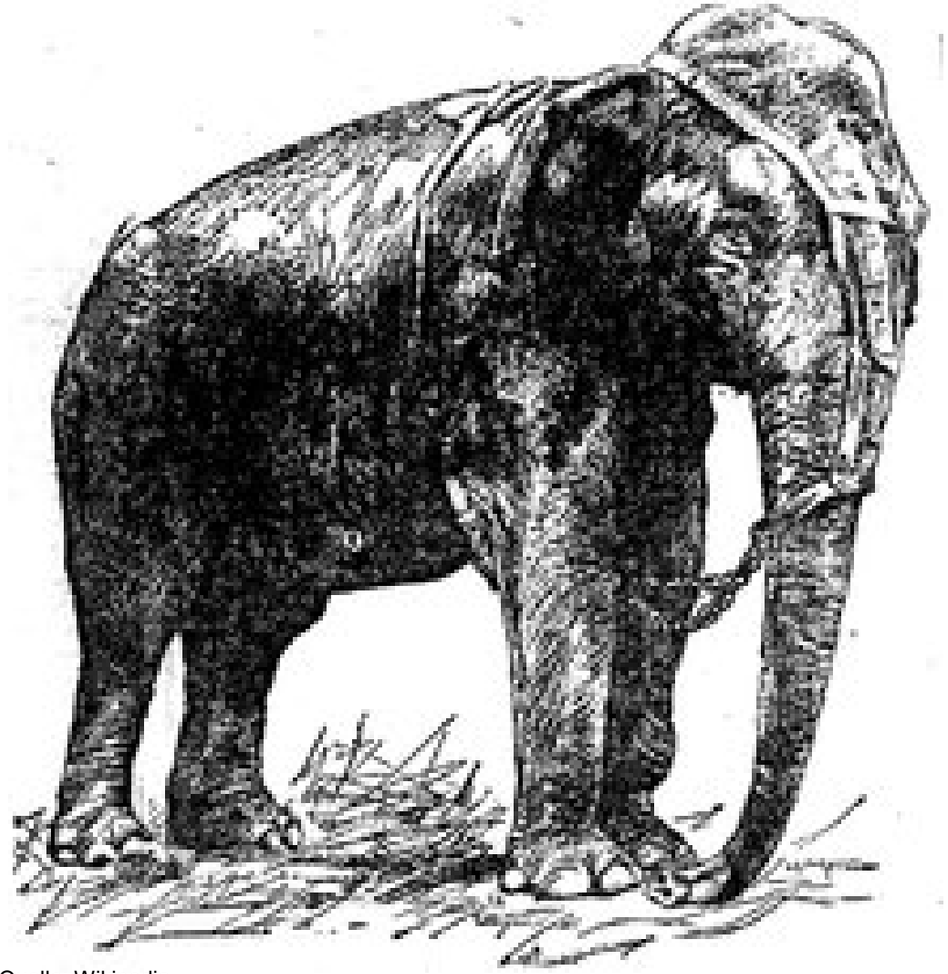
Parametric Pods: Forschung Projekt



Heating and cooling surface parametrisation







Quelle: Wikipedia

Computational Thinking ist für Parametric Design notwendig. In der Architektur weisen viele Kritiker auf kreative Aspekte hin.....

Sicher, es ist gefährlich für die Kreativität, genau wie Wechselstrom, wie er von Thomas Edison präsentiert wird, der Topsy den Elefanten tötet.....

(Der kreative Prozess der Problemlösung muss vollständig von der Programmierung getrennt sein.).