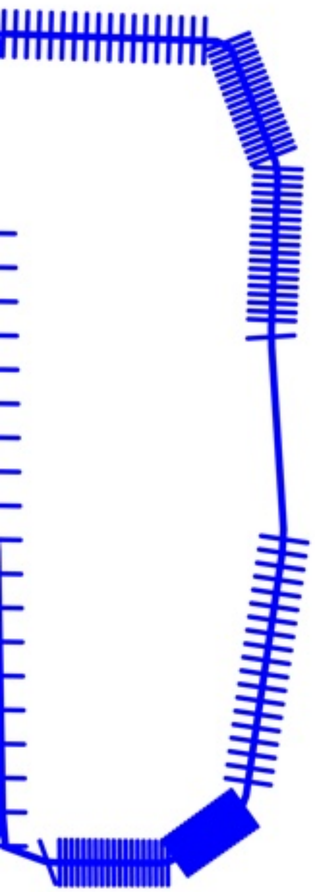

Deep Learning aligned with *Type Design*

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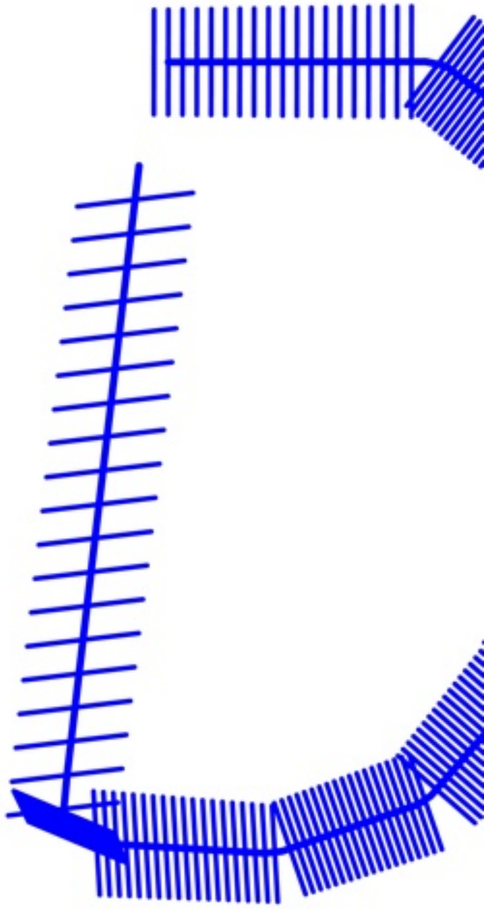
lgoncalo@dei.uc.pt

JÉSSICA PARENTE
jparente@dei.uc.pt



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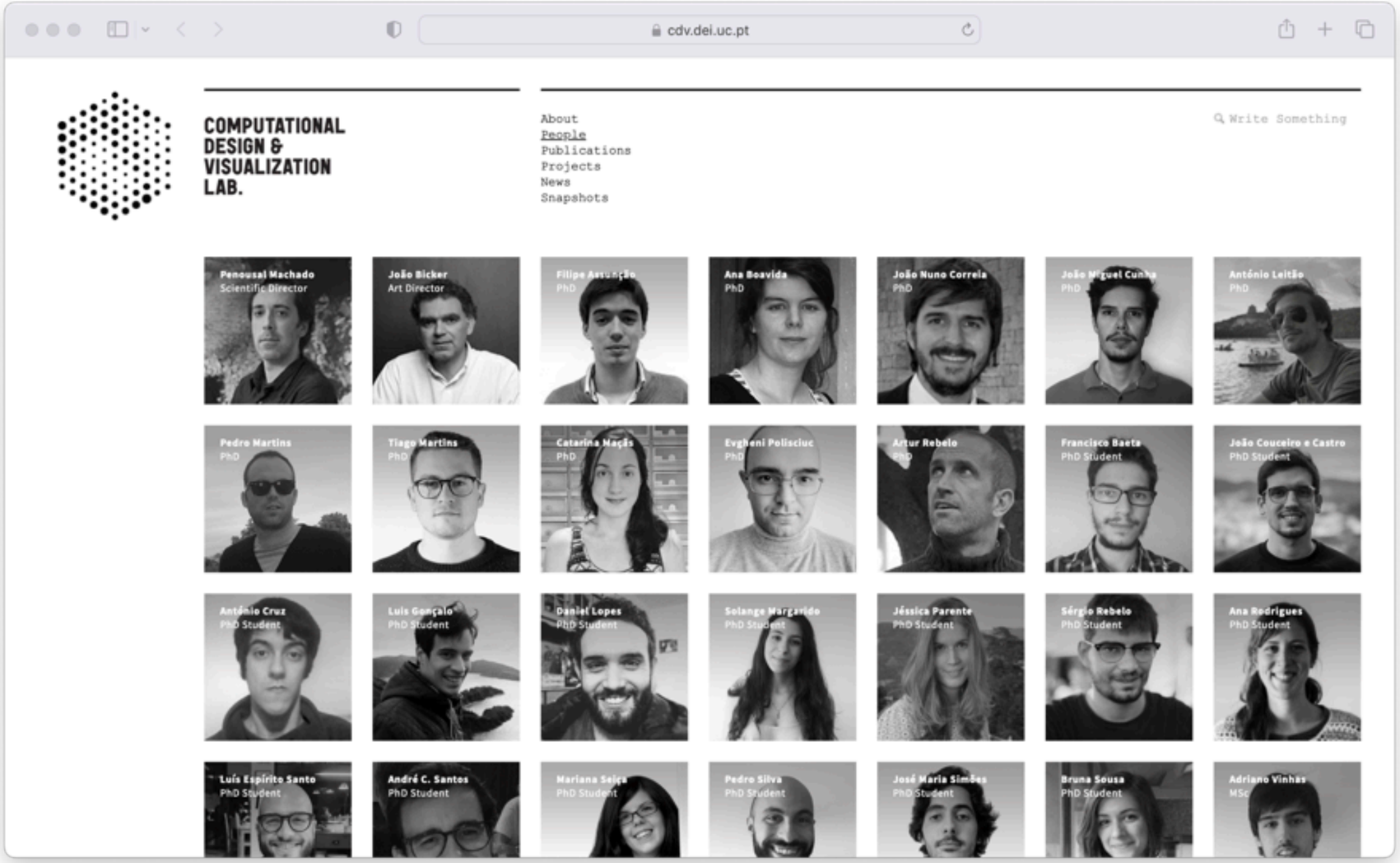
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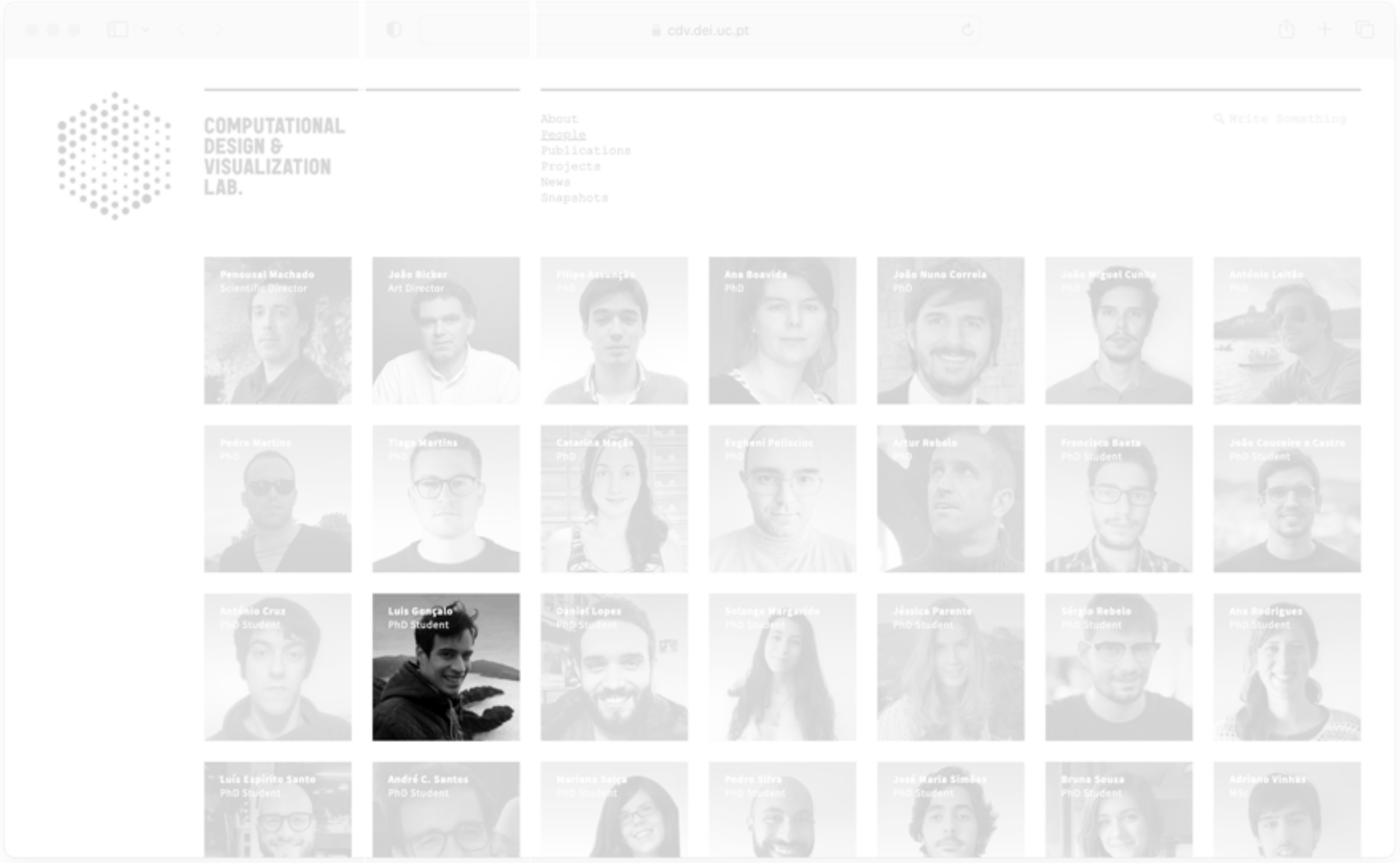
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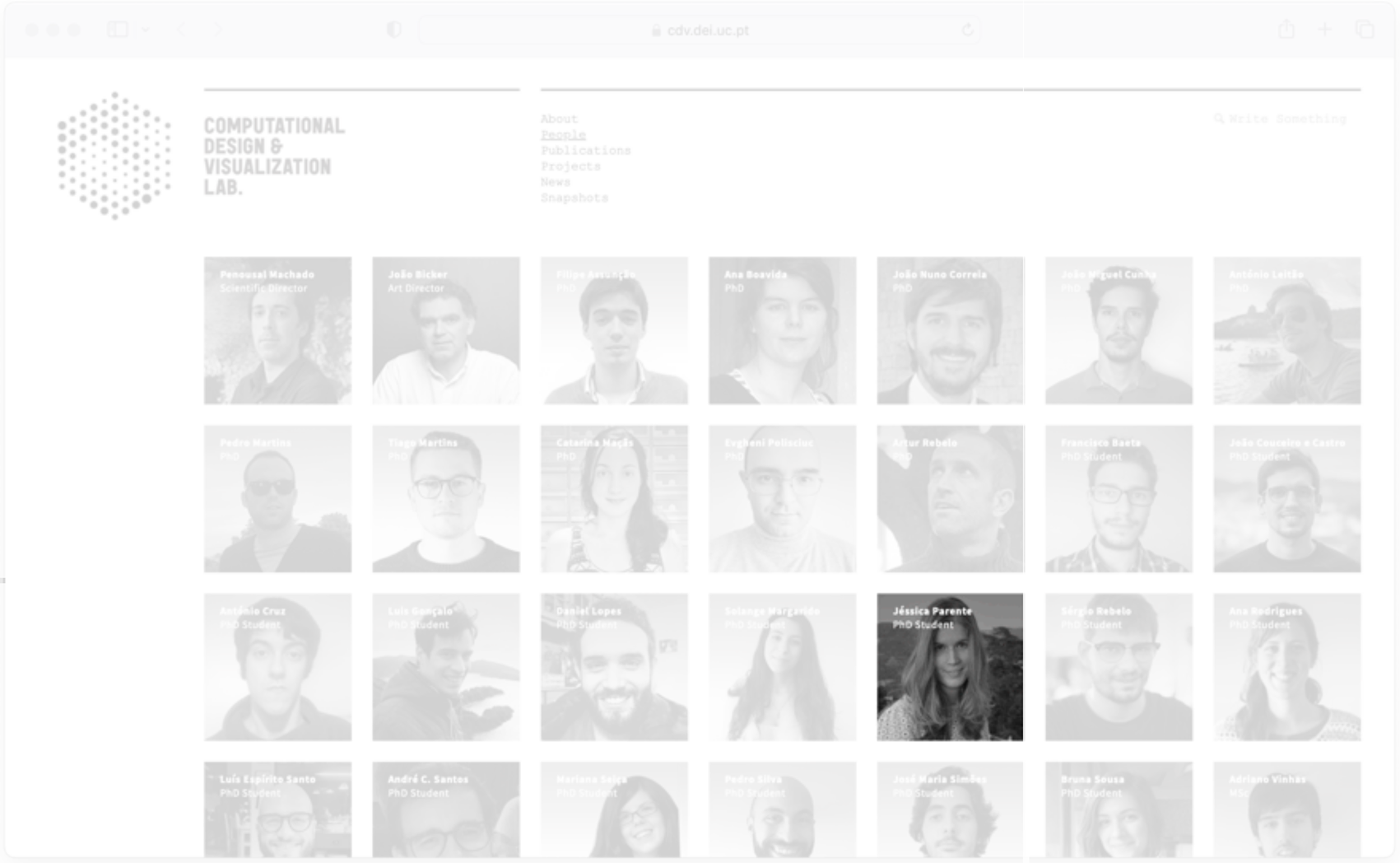
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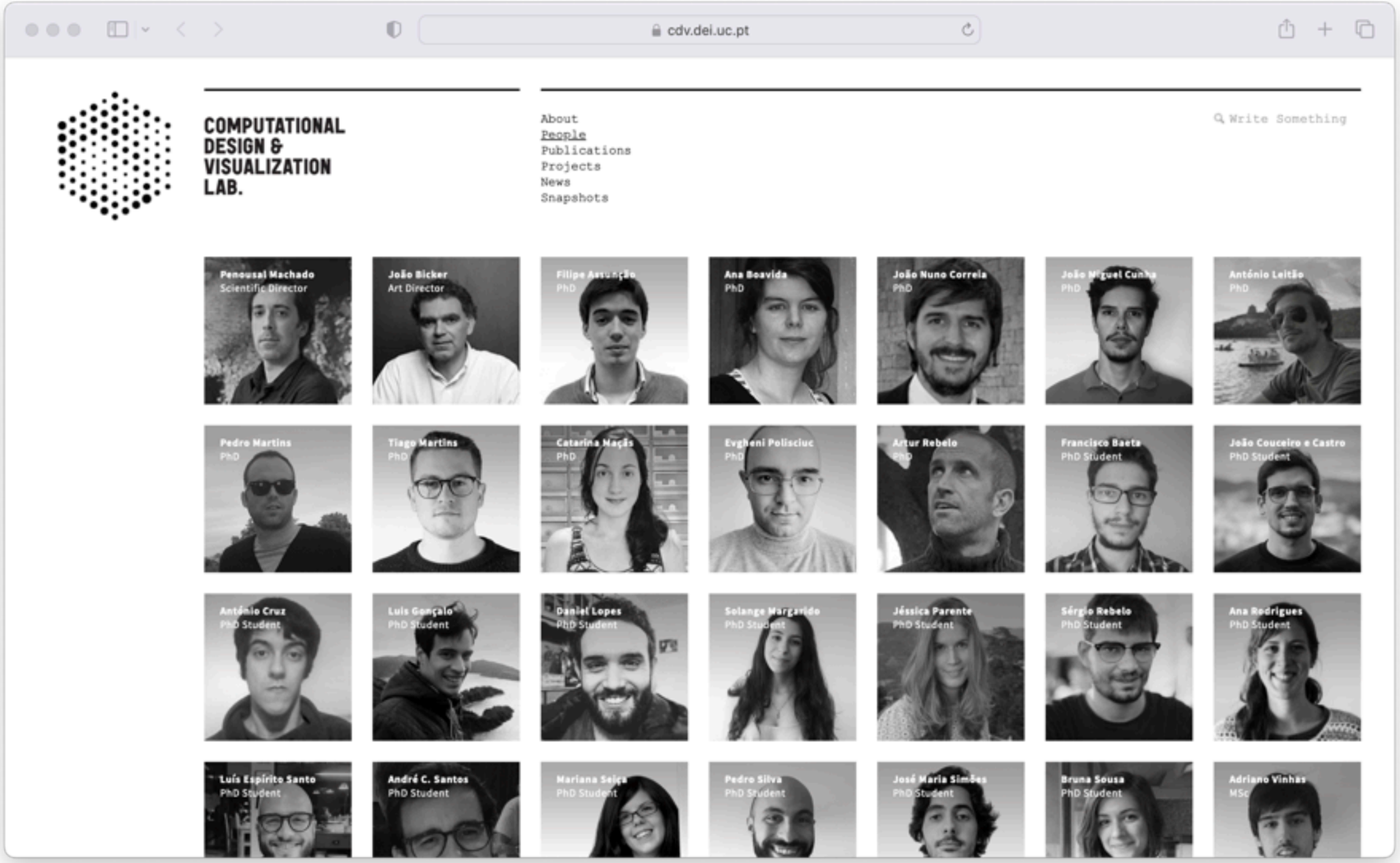
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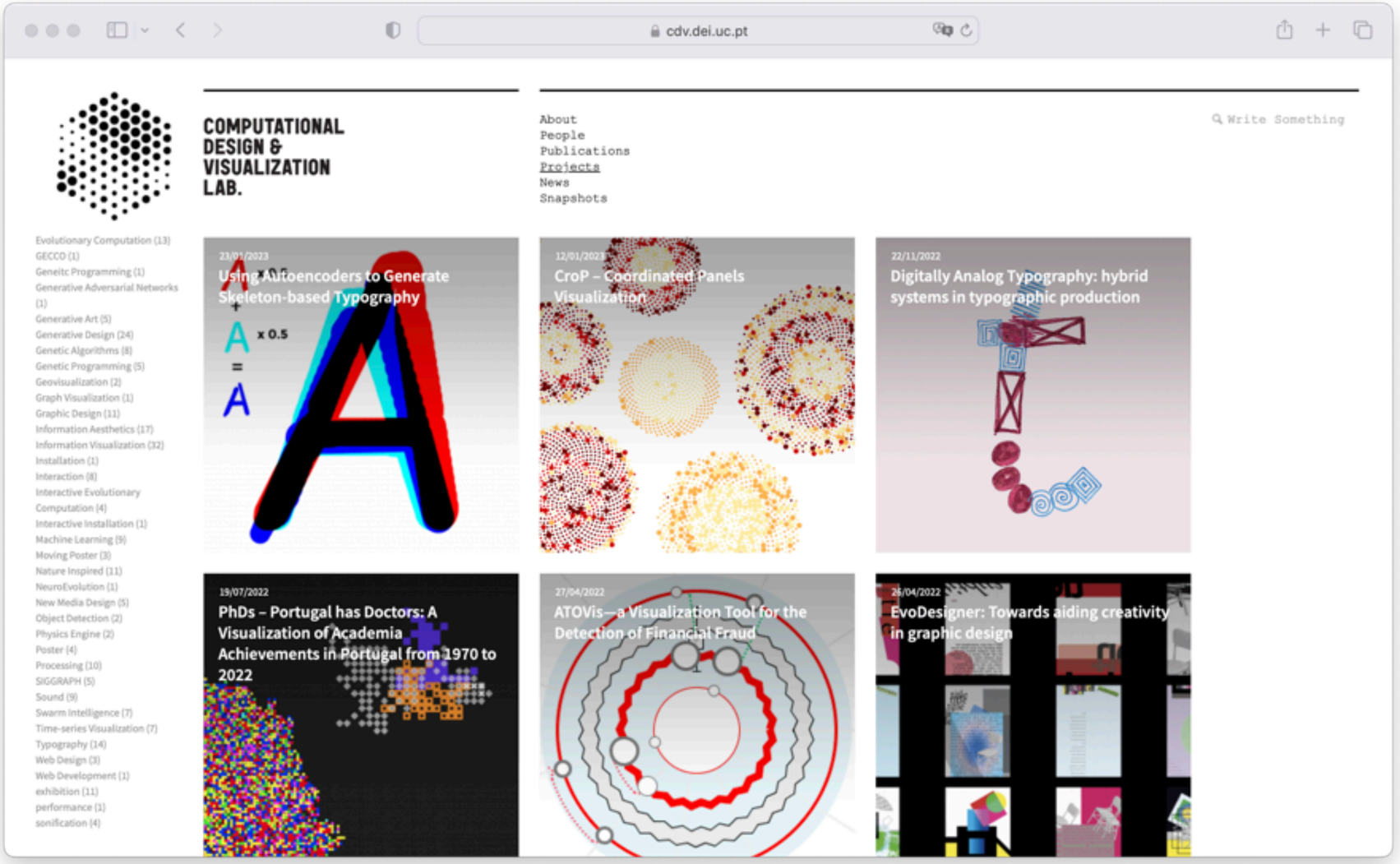
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GECCO (1)
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Generative Adversarial Networks (1)
Generative Art (5)
Generative Design (24)
Genetic Algorithms (8)
Genetic Programming (5)
Geovisualization (2)
Graph Visualization (1)
Graphic Design (11)
Information Aesthetics (17)
Information Visualization (32)
Installation (1)
Interaction (8)
Interactive Evolutionary Computation (4)
Interactive Installation (1)
Machine Learning (9)
Moving Poster (3)
Nature Inspired (11)
NeuroEvolution (1)
New Media Design (5)
Object Detection (2)
Physics Engine (2)
Poster (4)
Processing (10)
SIGGRAPH (5)
Sound (9)
Swarm Intelligence (7)
Time-series Visualization (7)
Typography (14)
Web Design (3)
Web Development (1)
exhibition (11)
performance (1)
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Using Autoencoders to Generate Skeleton-based Typography
x 0.5
12/01/2023
CroP – Coordinated Panels Visualization
22/11/2022
Digitally Analog Typography: hybrid systems in typographic production
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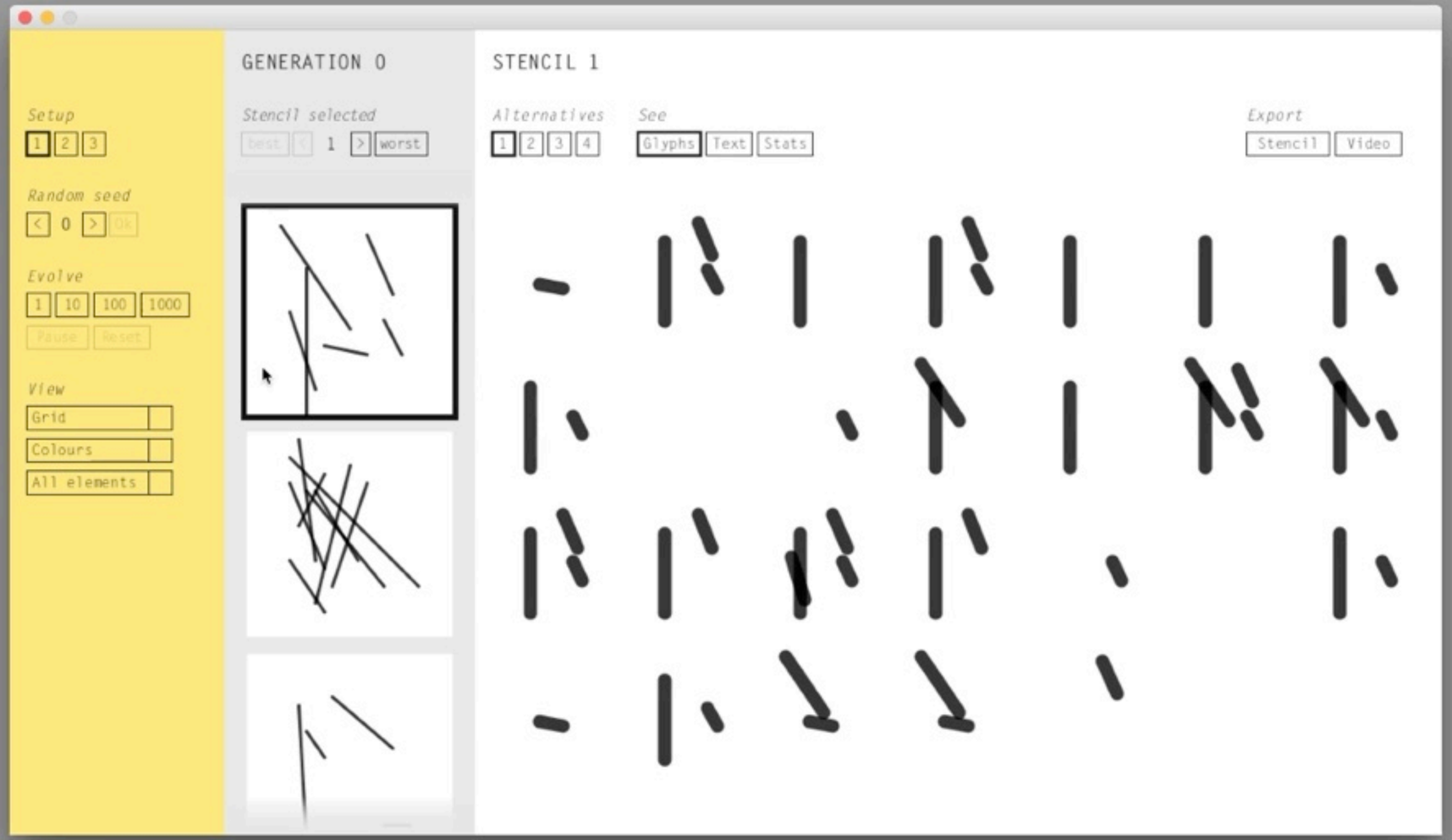
POSTER FACTORY, Sérgio Rebelo, João Bicker and Penousal Machado, 2017 - 2020
HTTPS://CDV.DEI.UC.PT/POSTERS-FACTORY/



EVOTYPE, Tiago Martins, João Nuno Correia, Ernesto Costa and Penousal Machado, 2018
HTTPS://CDV.DEI.UC.PT/EVOTYPE/

ÁDEA, Daniel Lopes, João Nuno Correia and Penousal Machado, 2020
HTTPS://CDV.DEI.UC.PT/ADEA/ HTTPS://ADEA.DEI.UC.PT/

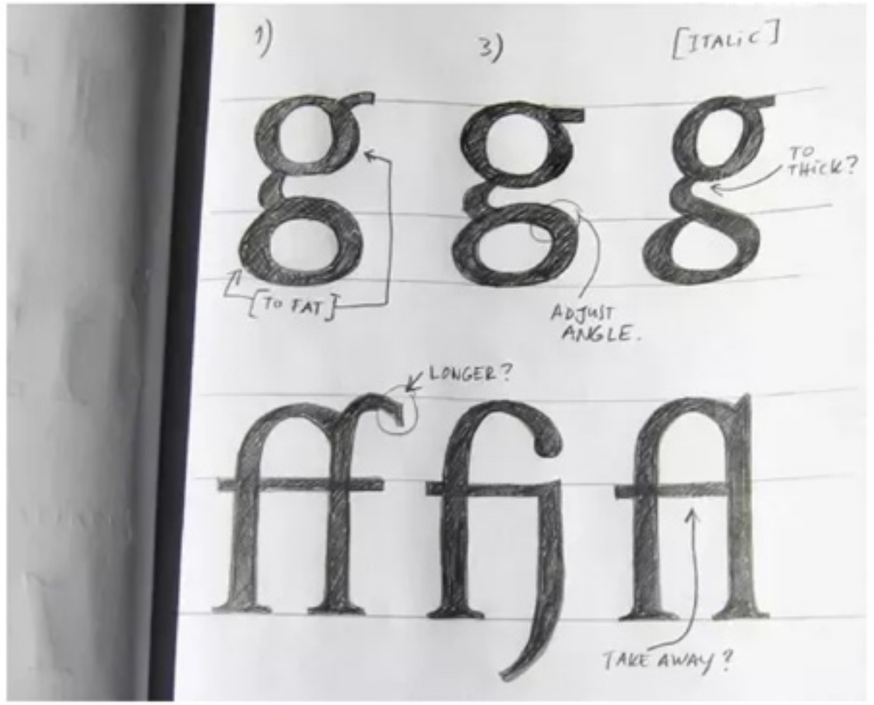
GENERATIVE TYPE DESIGN, Jéssica Parente,Tiago Martins, João Bicker and Penousal Machado, 2020
HTTPS://CDV.DEI.UC.PT/GENERATIVE-TYPE-DESIGN/

Motivation

Laborous work

Laborous work

Type Design is a time-consuming and complex discipline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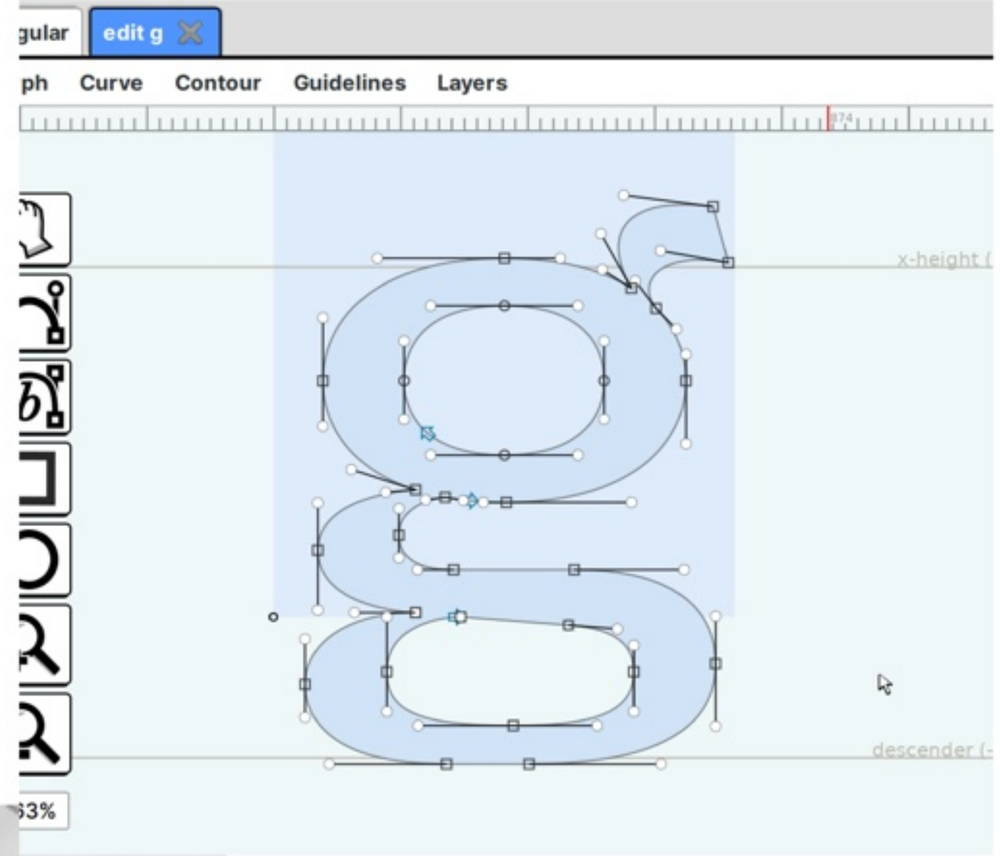
TO THICK?
TO FAT
ADJUST ANGLE.
LONGER?
TAKE AWAY?


TAKE AWAY ?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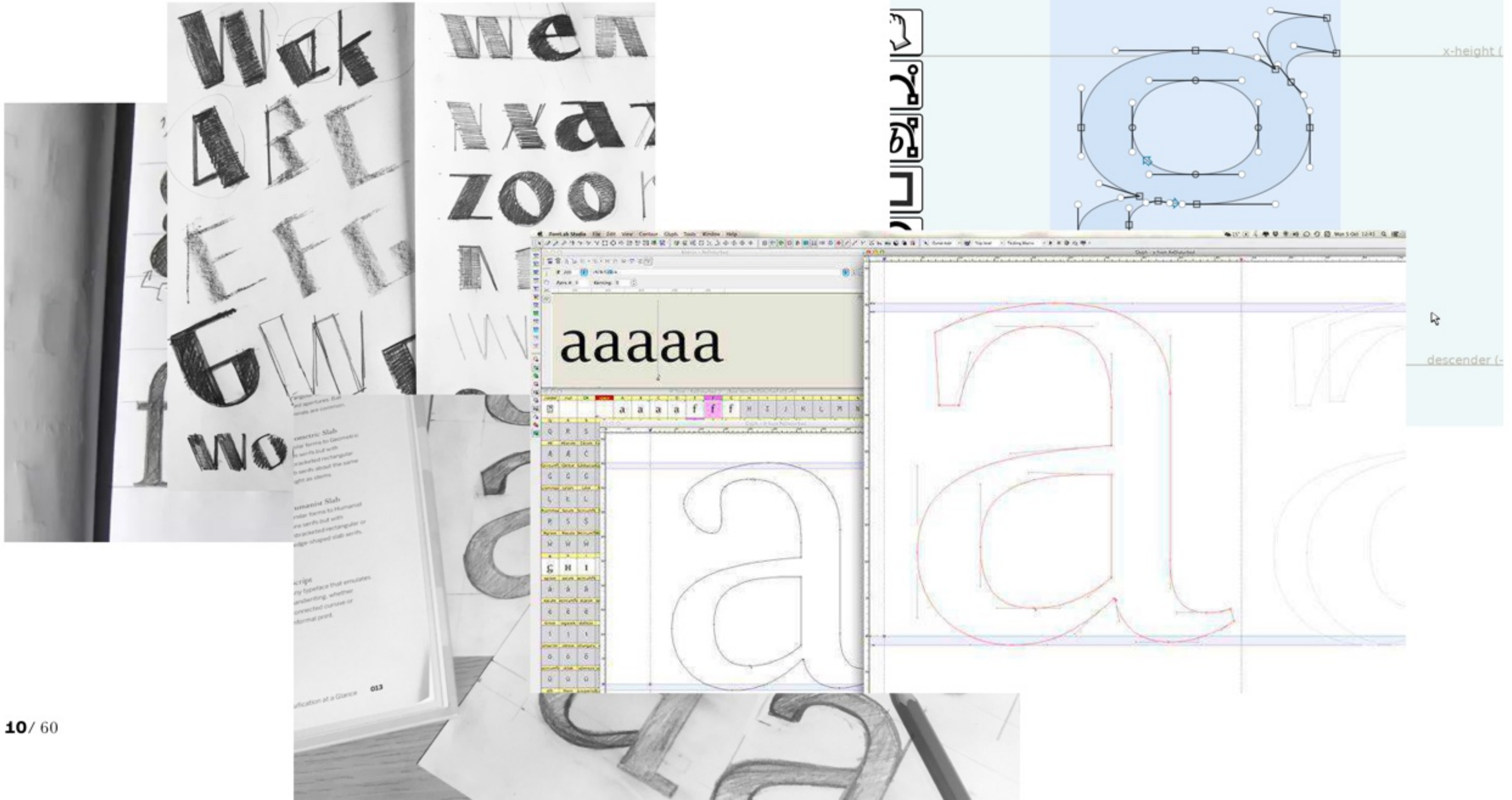
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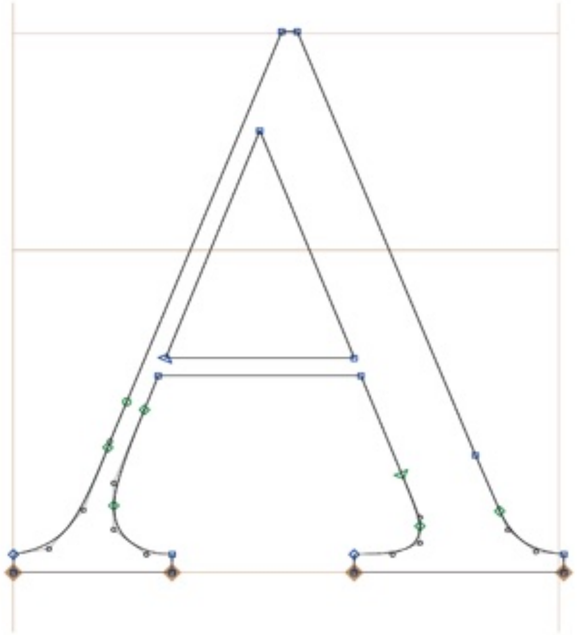

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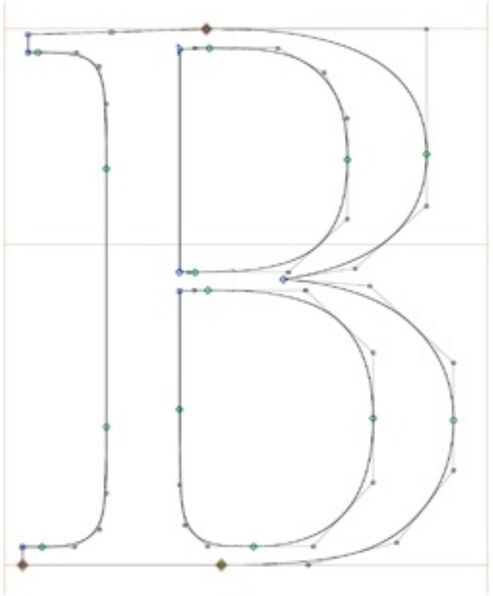
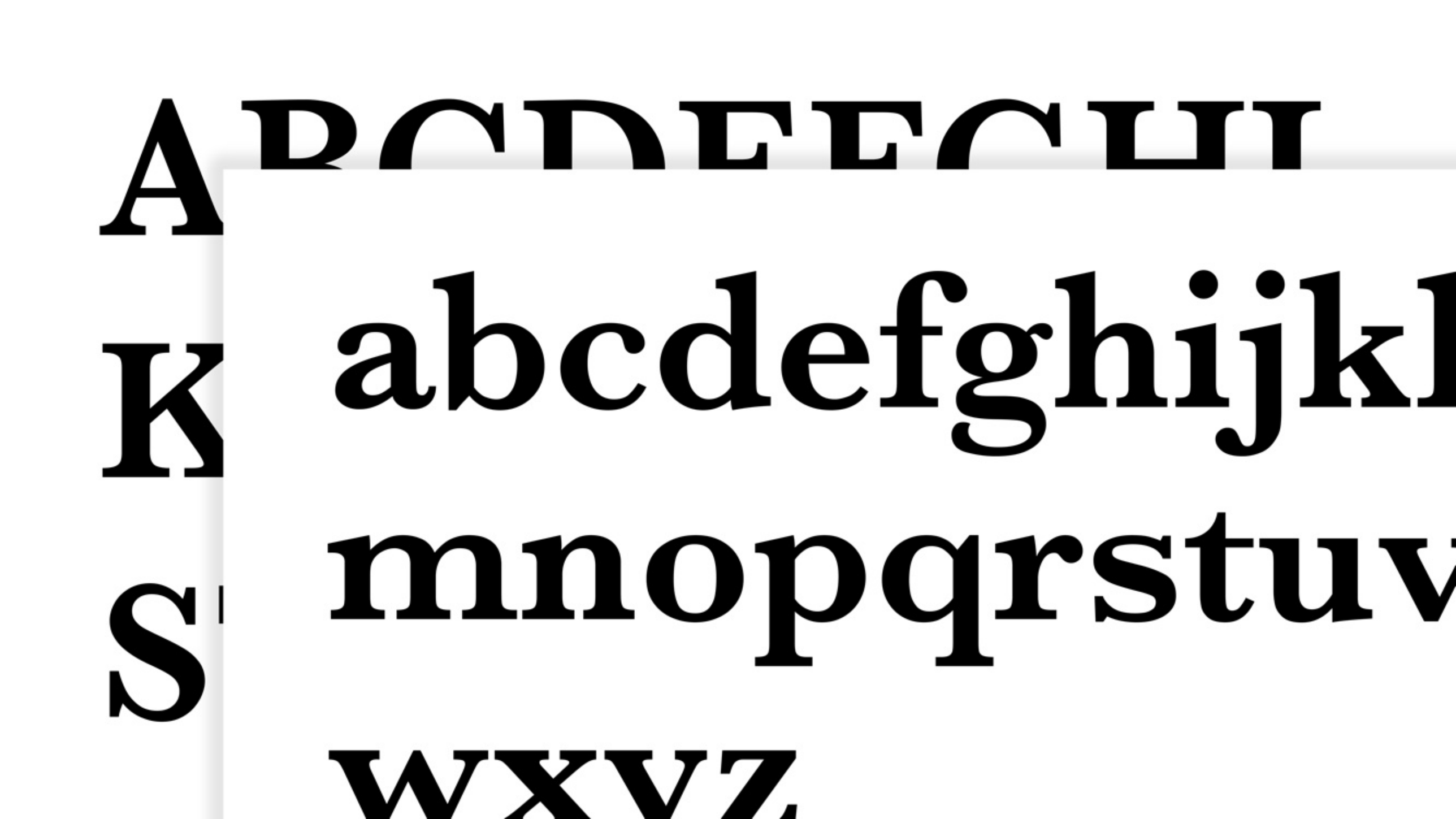


ABCDEFGHI

KLMNOPQR

STUVWXYZ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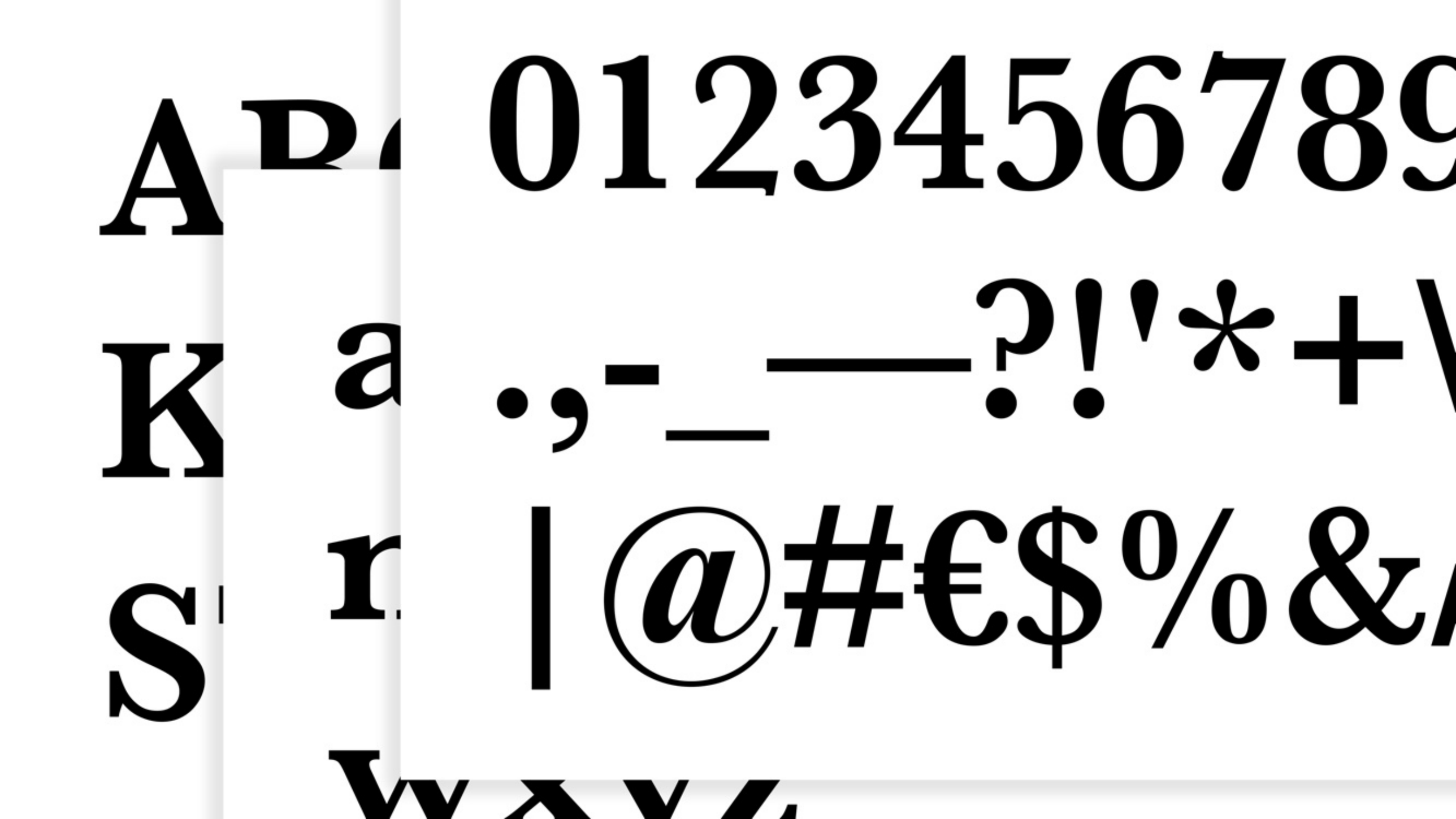
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Laborous work

Type Design is a time-consuming
and complex discipline

Take advantage of Machine Learning

DEEP-FONTS, Erik Bernhardsson, 2016

DEEP-FONTS, Erik Bernhardsson, 2016

GLYPHGAN, Hideaki Hayashi, Kohtaro Abe, Seiichi Uchida, 2019

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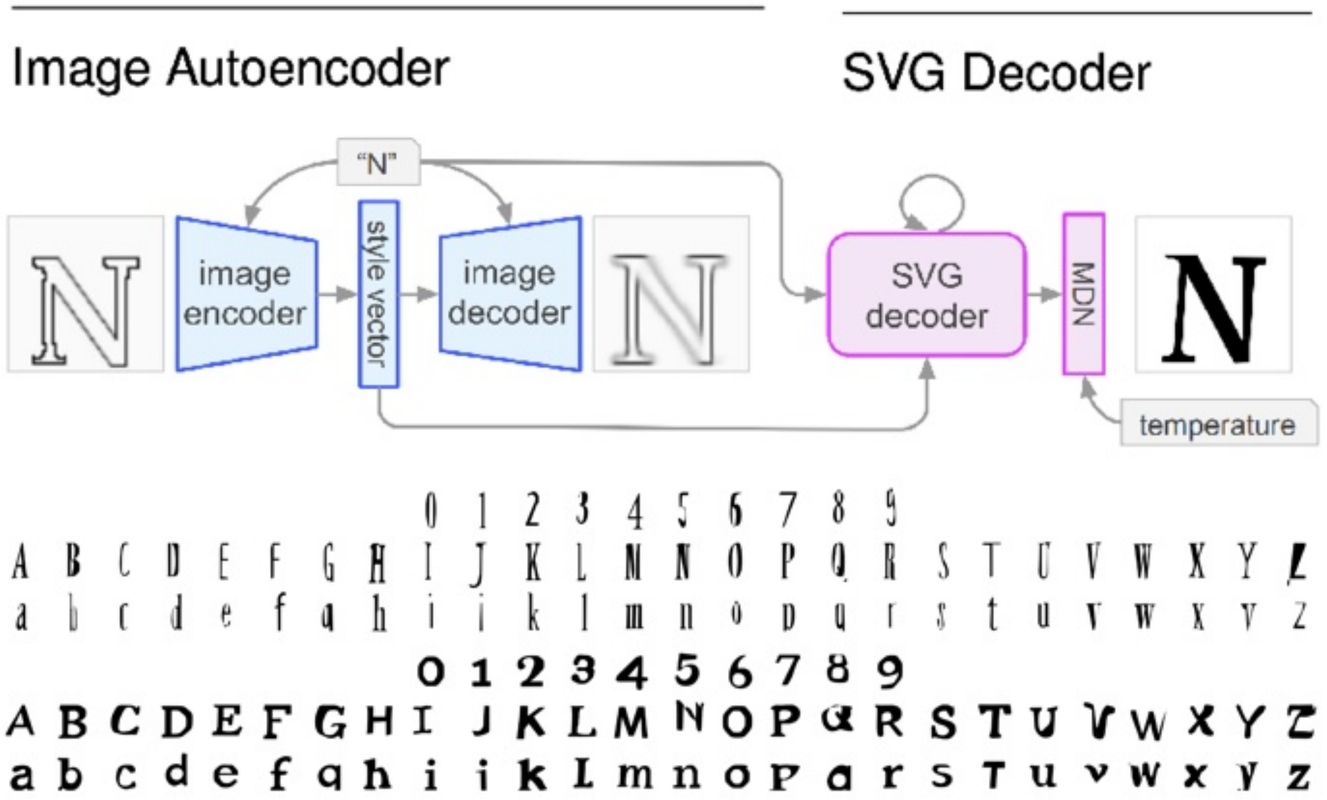
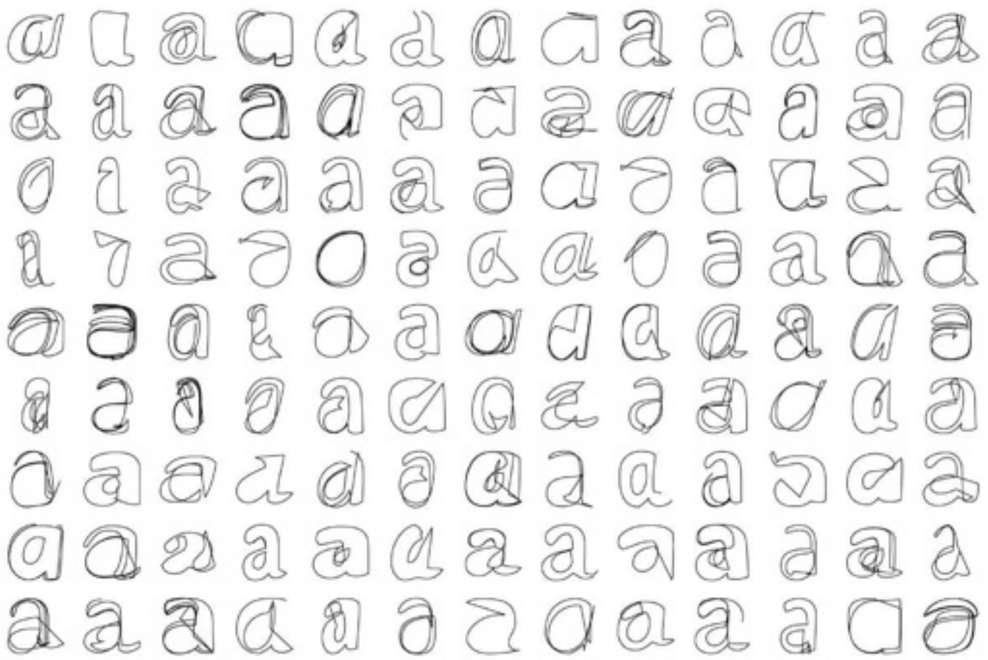
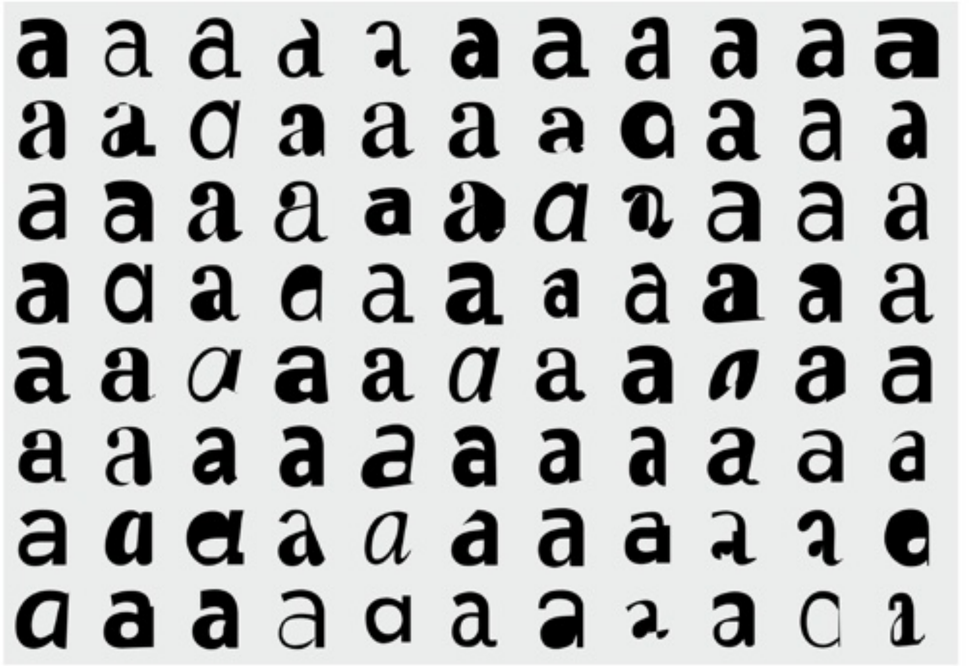
Friendship ended with
pixels
Now
SVG
is my
best friend



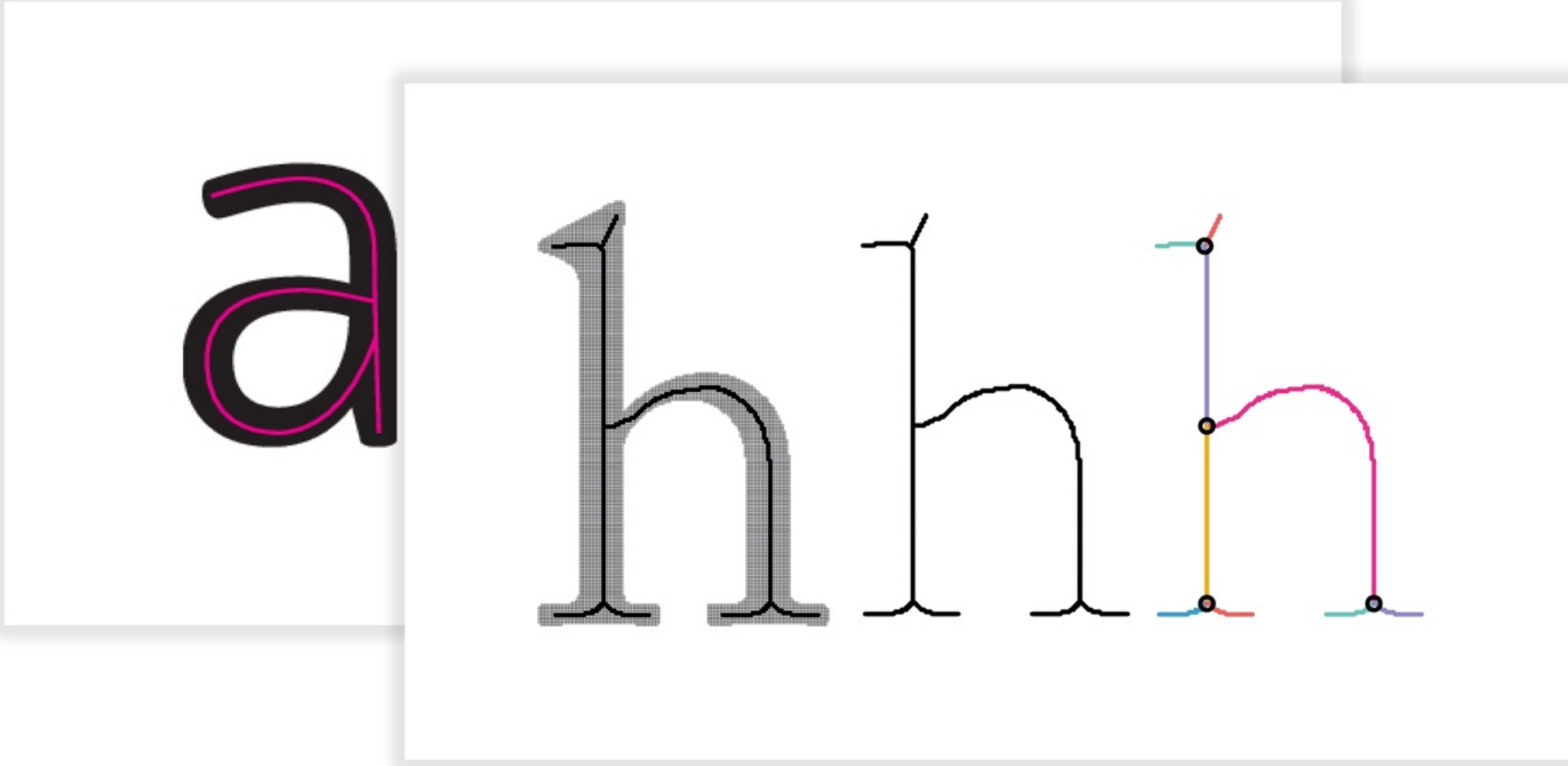
A LEARNED REPRESENTATION FOR SCALABLE VECTOR GRAPHICS,
Raphael Gontijo Lopes, David Ha, Douglas Eck, Jonathon Shlens



PATHFINDER, Jean Böhm,
[SketchRNN]



PATHFINDER, Jean Böhm,
[GPT2]



Laborous work

Type Design is a time-consuming
and complex discipline

Take advantage of Machine Learning

— Vector-based approach

Laborous work

Type Design is a time-consuming
and complex discipline

Take advantage of Machine Learning

— Vector-based approach
— Skeleton-based approach

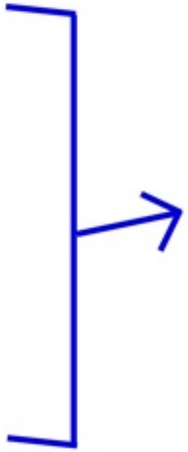
Laborous work

Type Design is a time-consuming and complex discipline

Take advantage of Machine Learning

— Vector-based approach

— Skeleton-based approach



Take advantage of these to create design artifacts

Goal

We propose an **Autoregressive model** that creates **new glyph skeletons** by **interpolating between existing ones**.

Data

Google Fonts

Serif,
Sans Serif,
Monospace,
Display,
Handwriting

Google Fonts

Serif,
Sans Serif,
Monospace,
Display,
Handwriting

Google Fonts

Serif,
Sans Serif,
Monospace,

Collection
of **2623 fonts**
in TTF format

Google Fonts

Serif,
Sans Serif,
Monospace,

Collection
of **2623 fonts**
in TTF format

×

26 characters
of the Latin alphabet
in their capital format

Google Fonts

Serif,
Sans Serif,
Monospace,

Collection
of **2623 fonts**
in TTF format

×

26 characters
of the Latin alphabet
in their capital format

Collection
of **68 198 glyphs**

Input Glyph

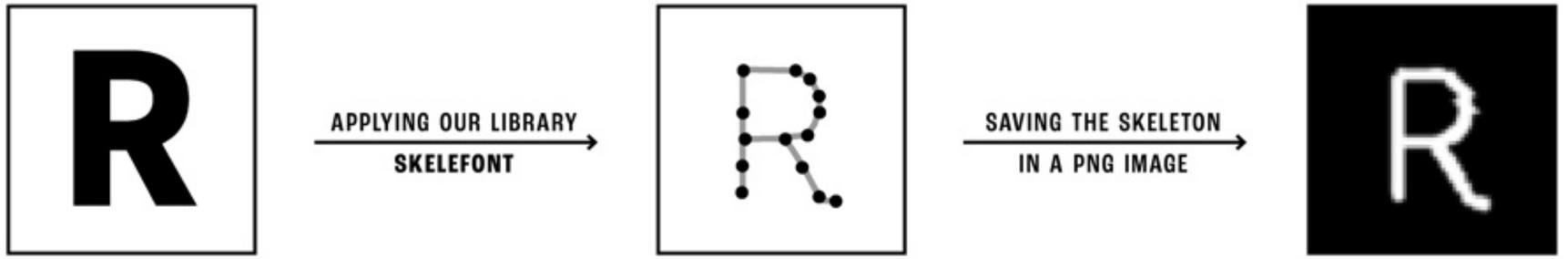
Each glyph of the collected data (68 198 glyphs)

Input Glyph

Each glyph of the collected data (68 198 glyphs)

Extracted Skeleton

A list of ordered: **point coordinates** and **stroke width**



Input Glyph

Each glyph of the collected data (68 198 glyphs)

Extracted Skeleton

A list of ordered: **point coordinates** and **stroke width**

Model's Input

64 x 64px b&w image

Network Architecture of the Conditional Variational Auto Encoder*

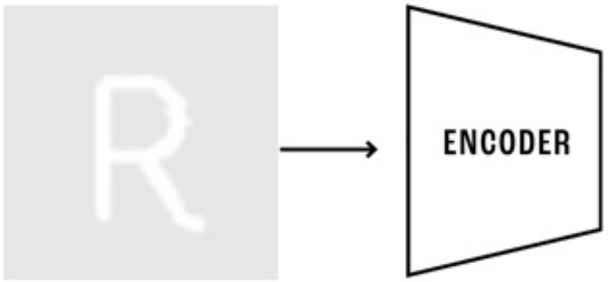
**Diederik P. Kingma and Max Welling, 2014*

Input

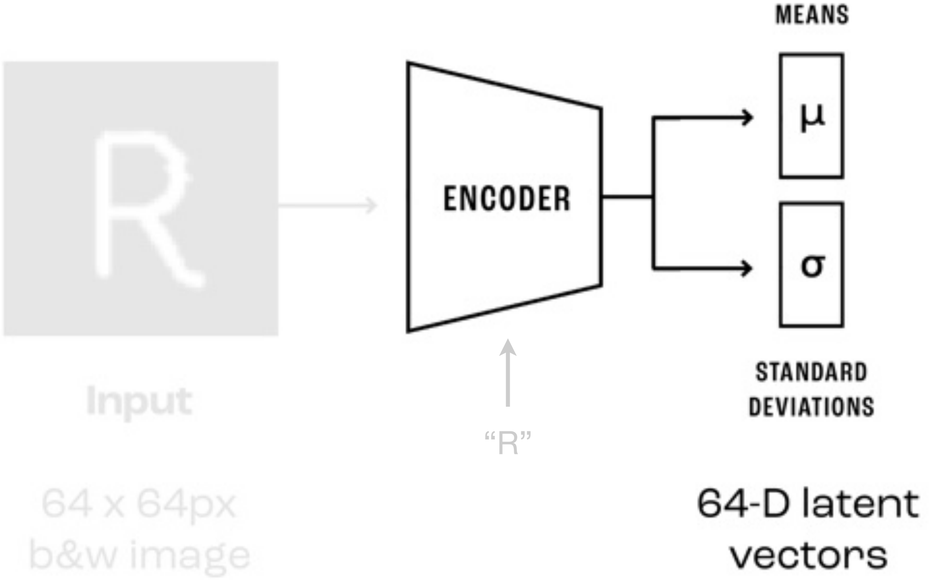
64 x 64px
b&w image

“R”

NETWORK ARCHITECTURE OF THE VAE



NETWORK ARCHITECTURE OF THE VAE



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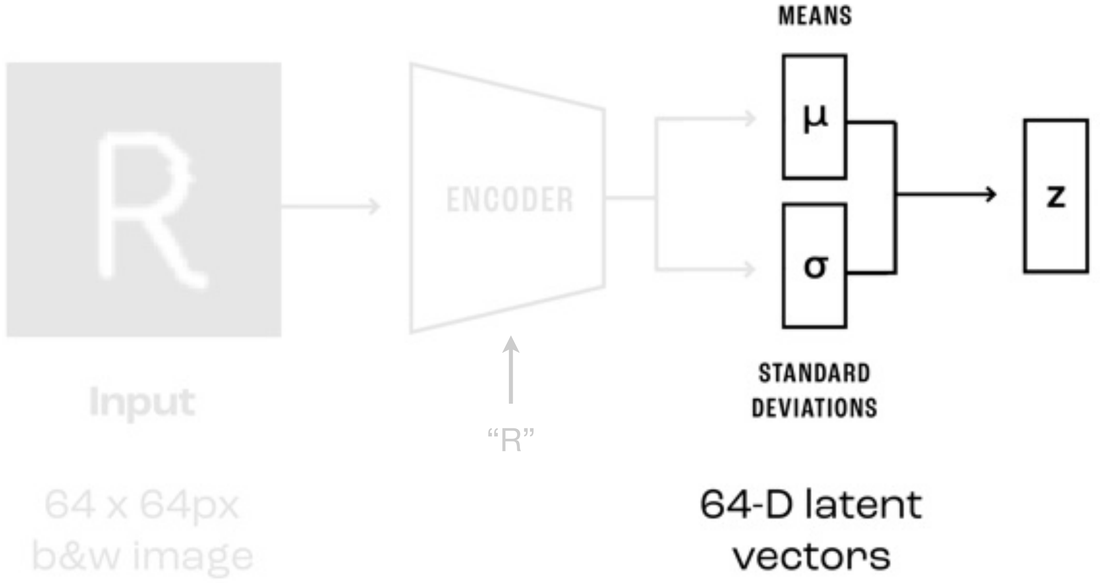

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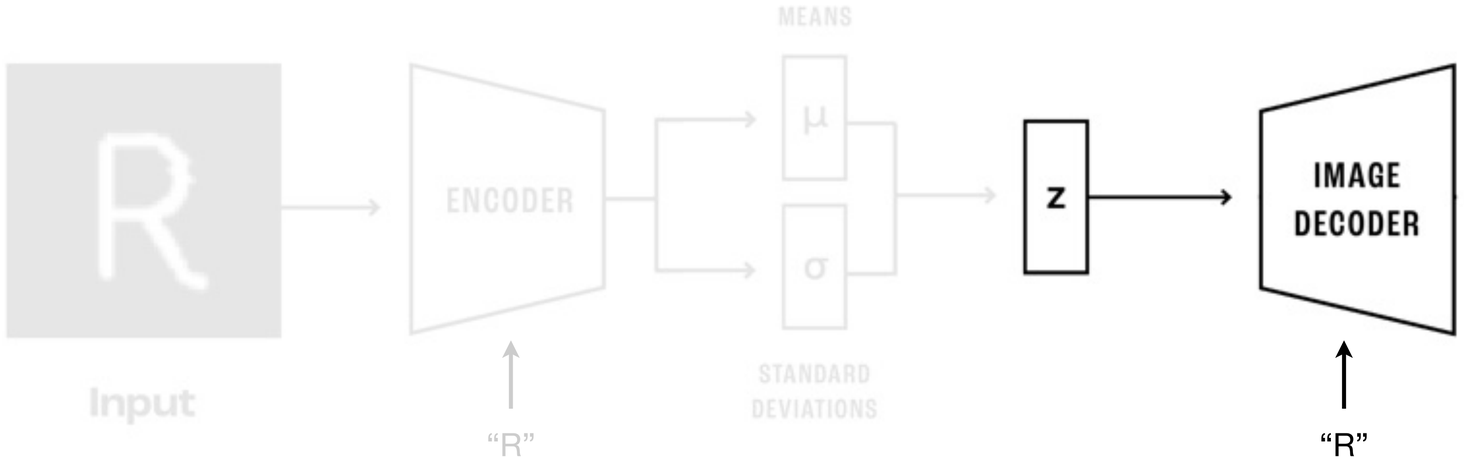

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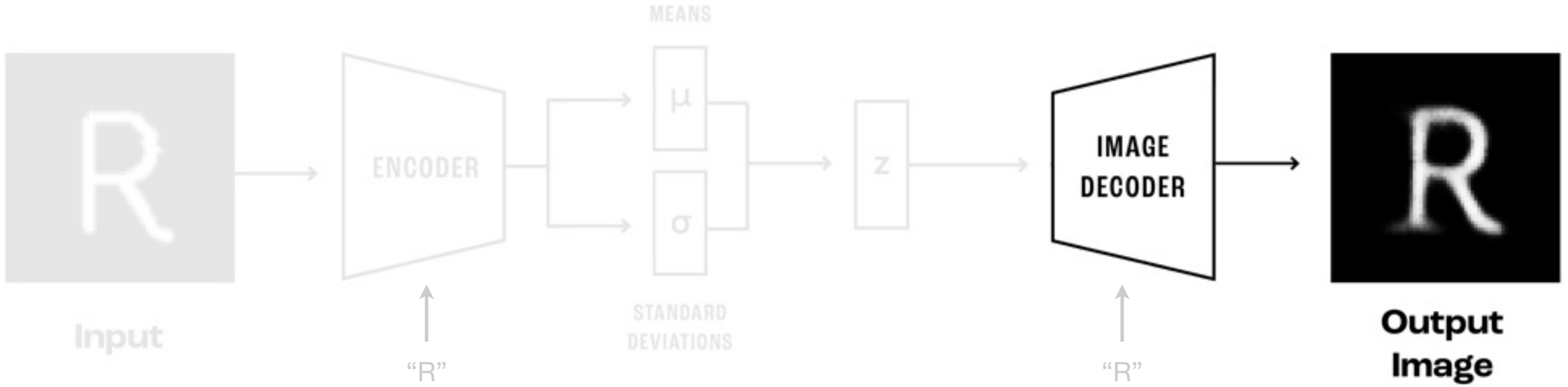

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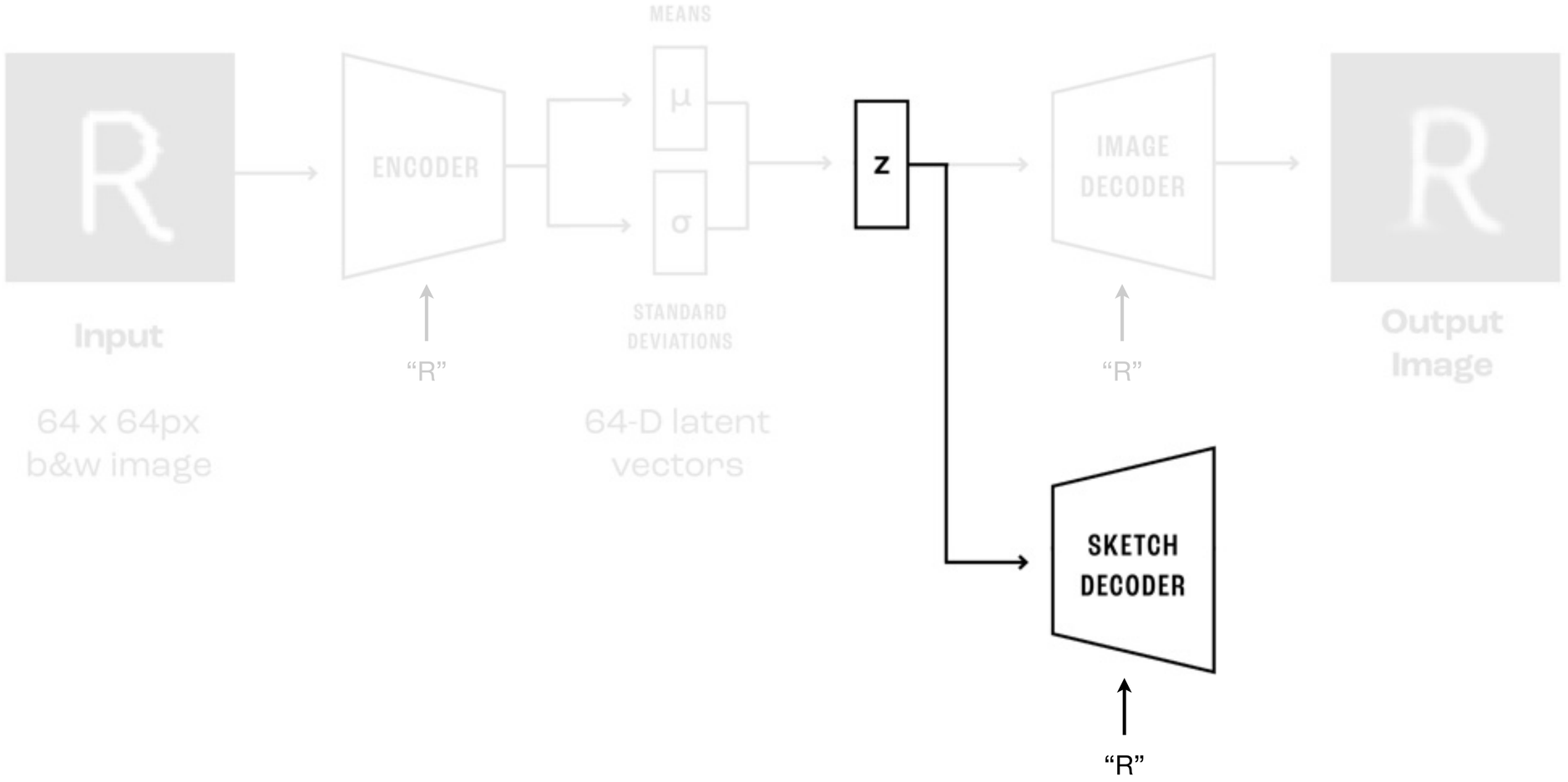

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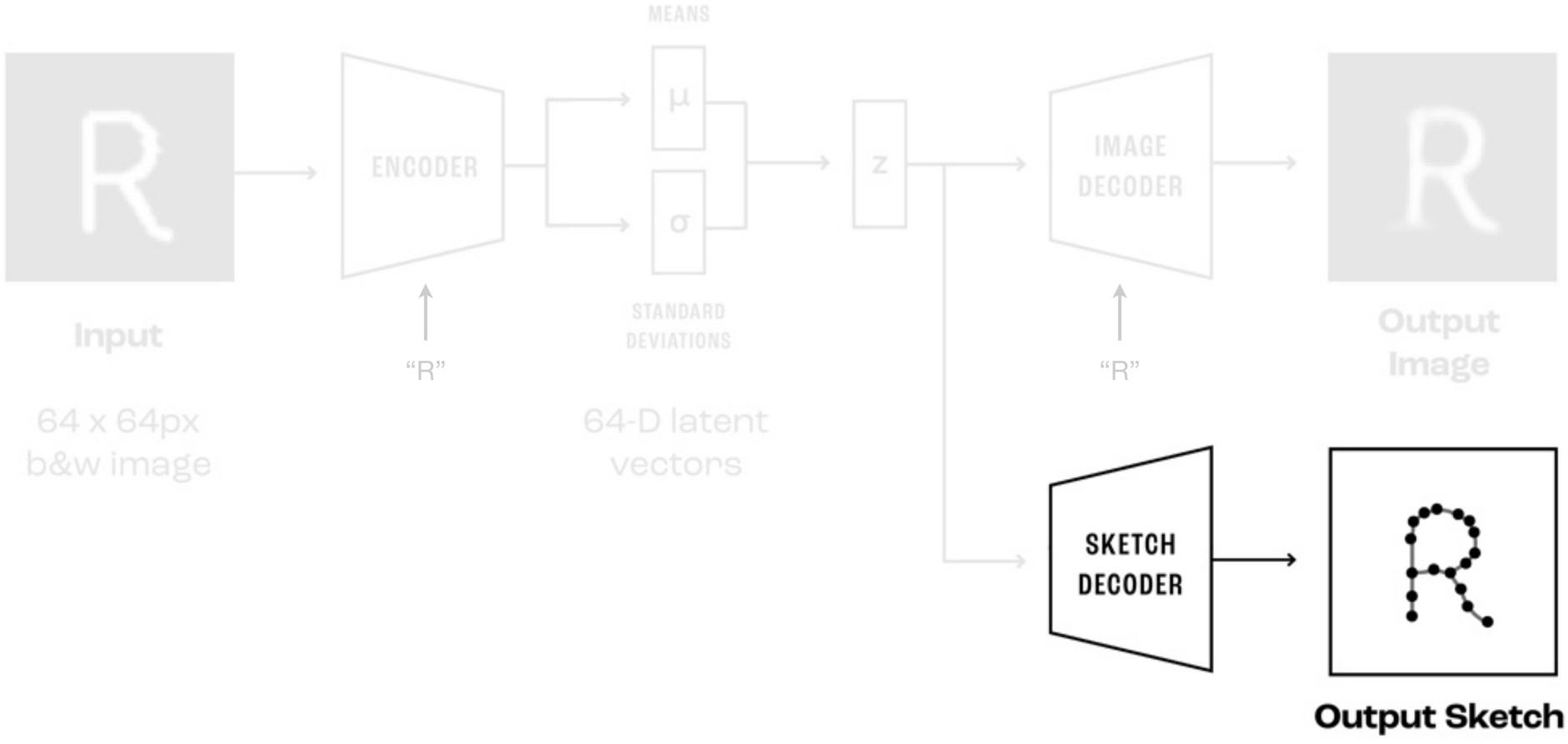
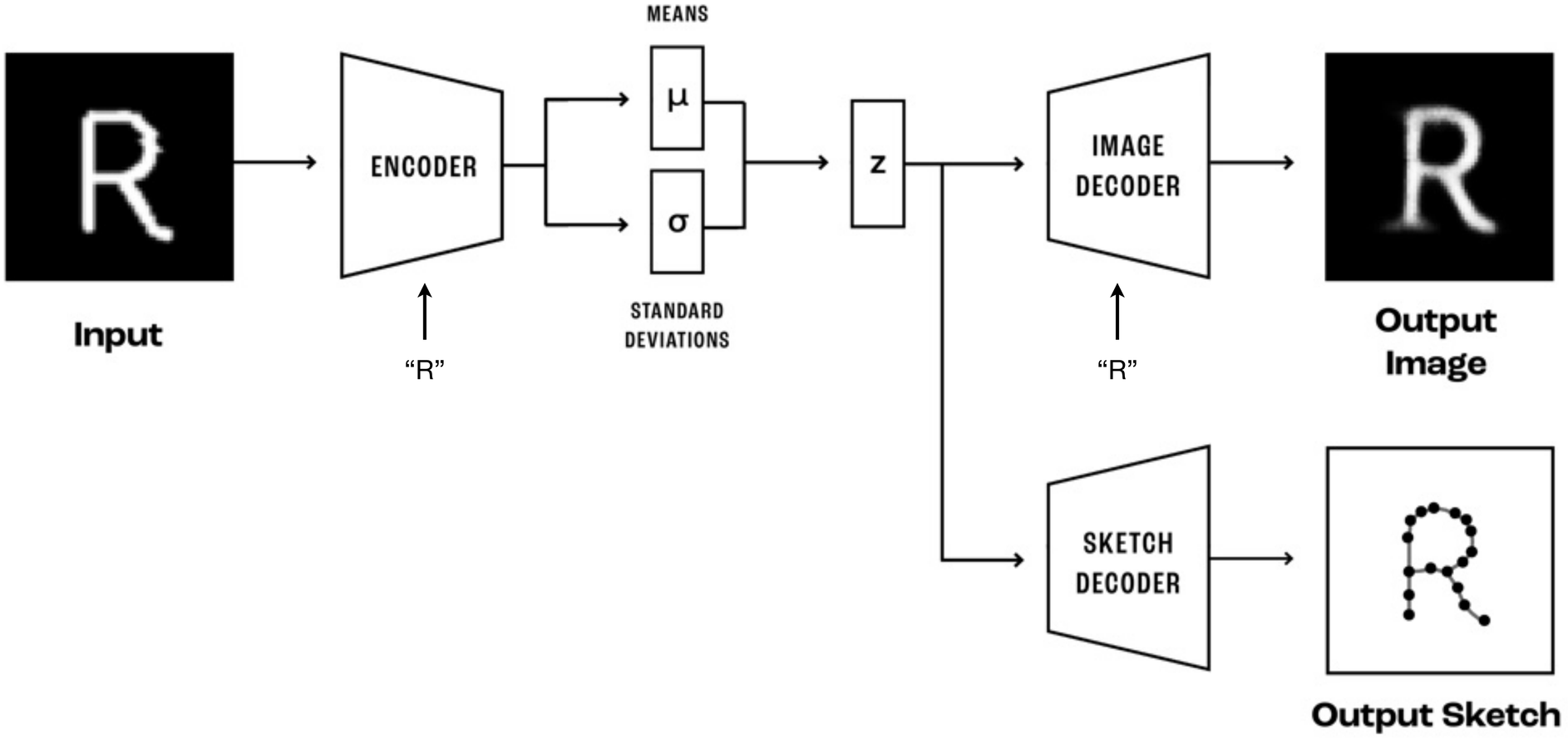


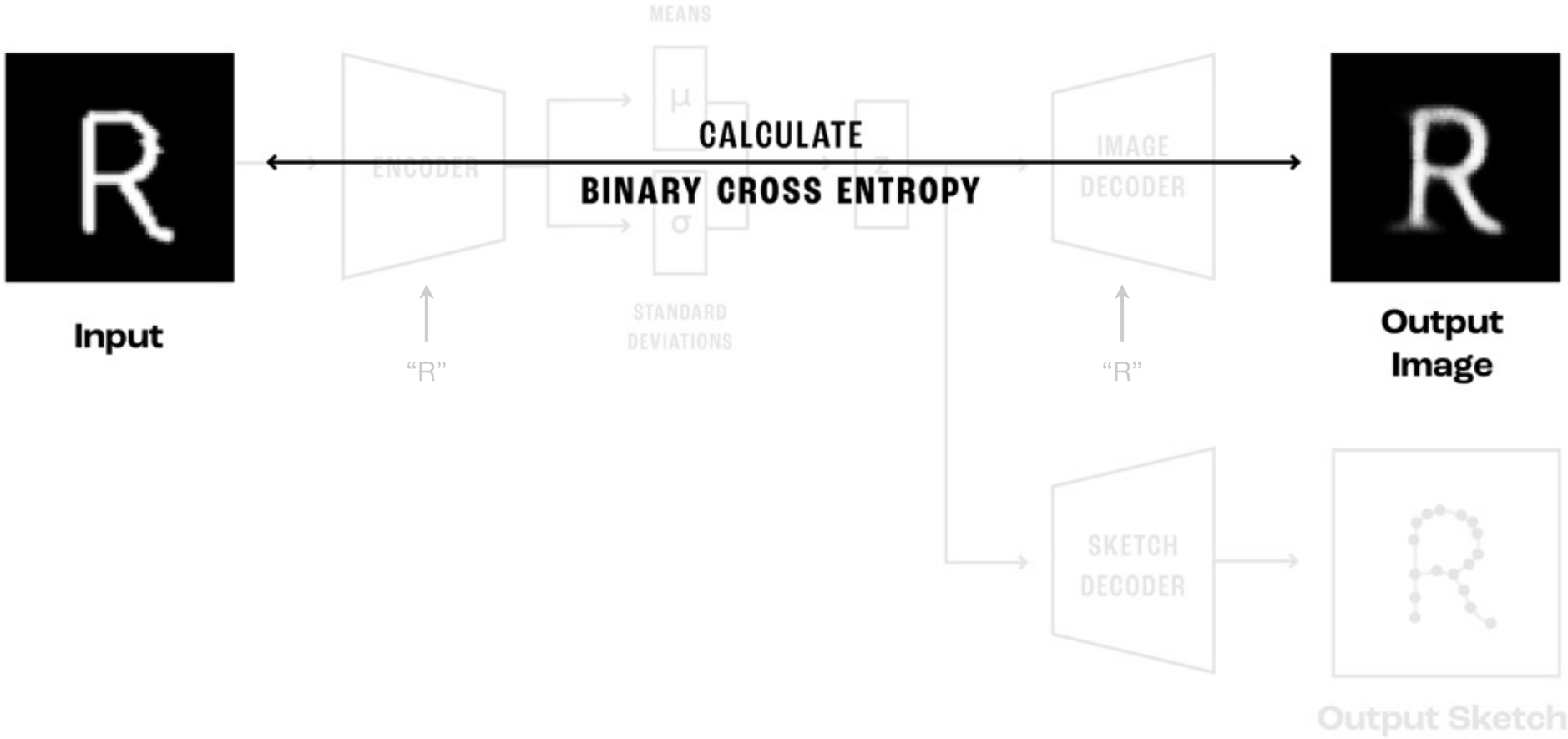
NETWORK ARCHITECTURE OF THE VAE

Network Architecture of the VAE

→ Loss Function



NETWORK ARCHITECTURE OF VAE — Loss Function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BINARY CROSS ENTROPY
IMAGE DECODER
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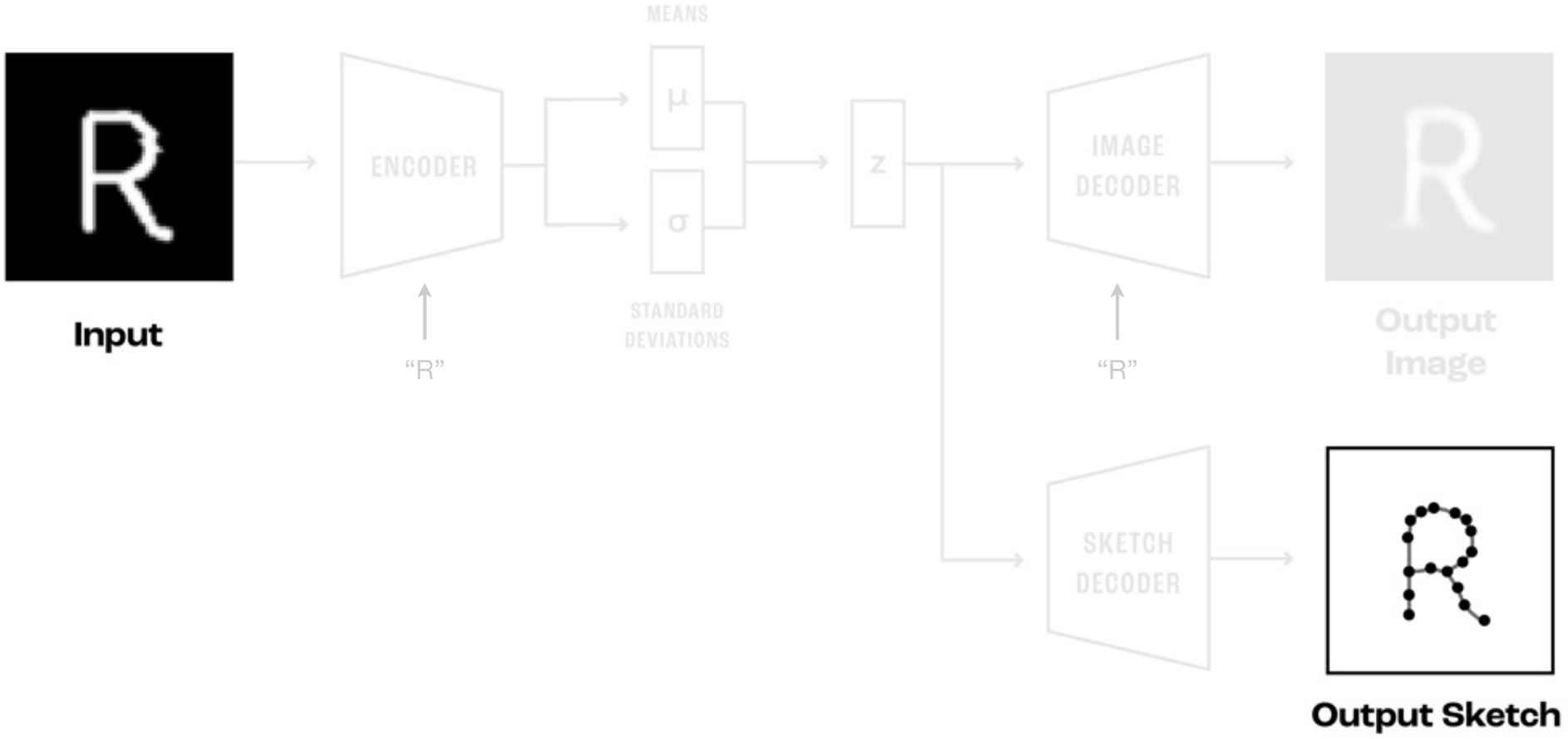
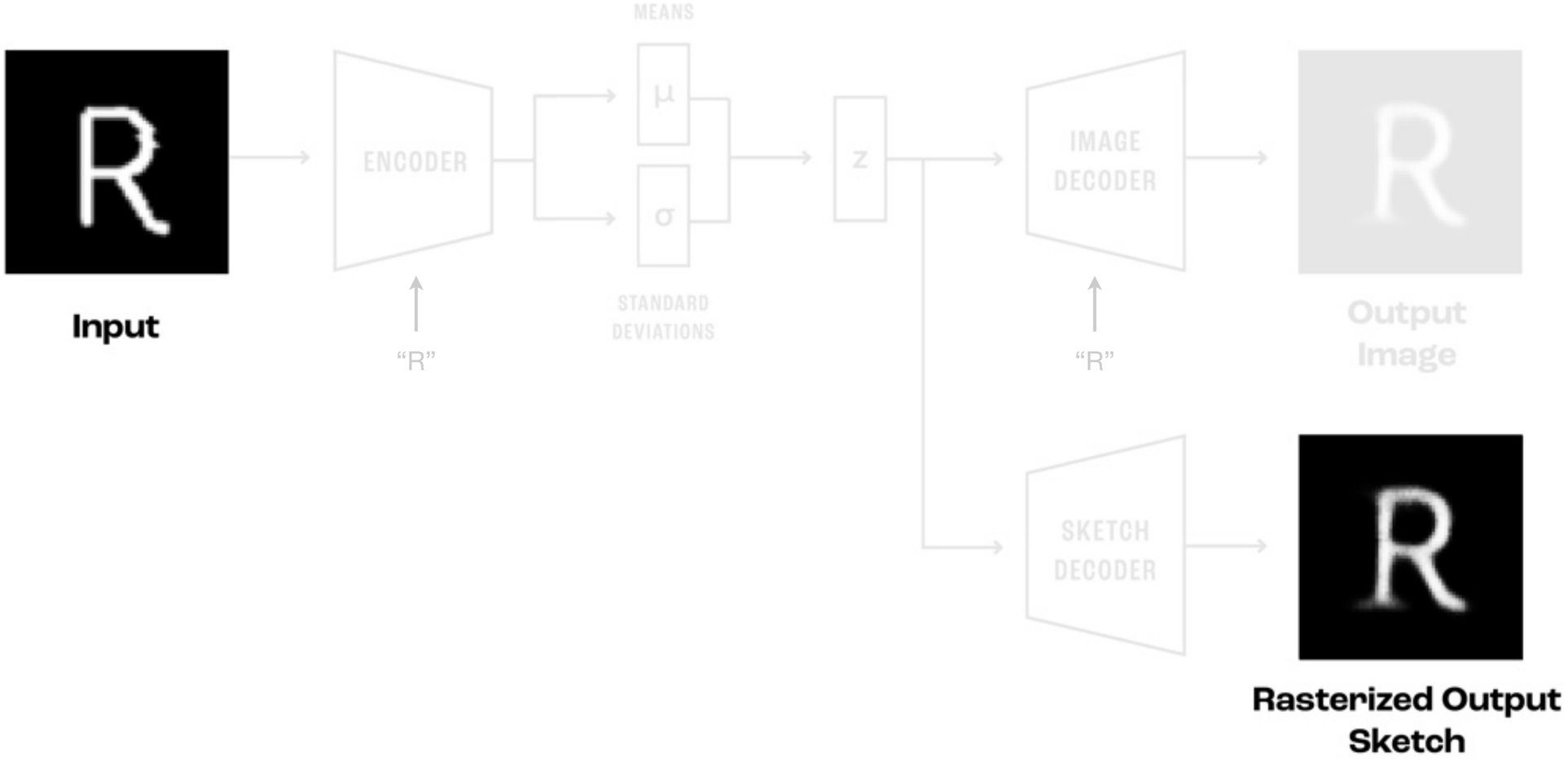
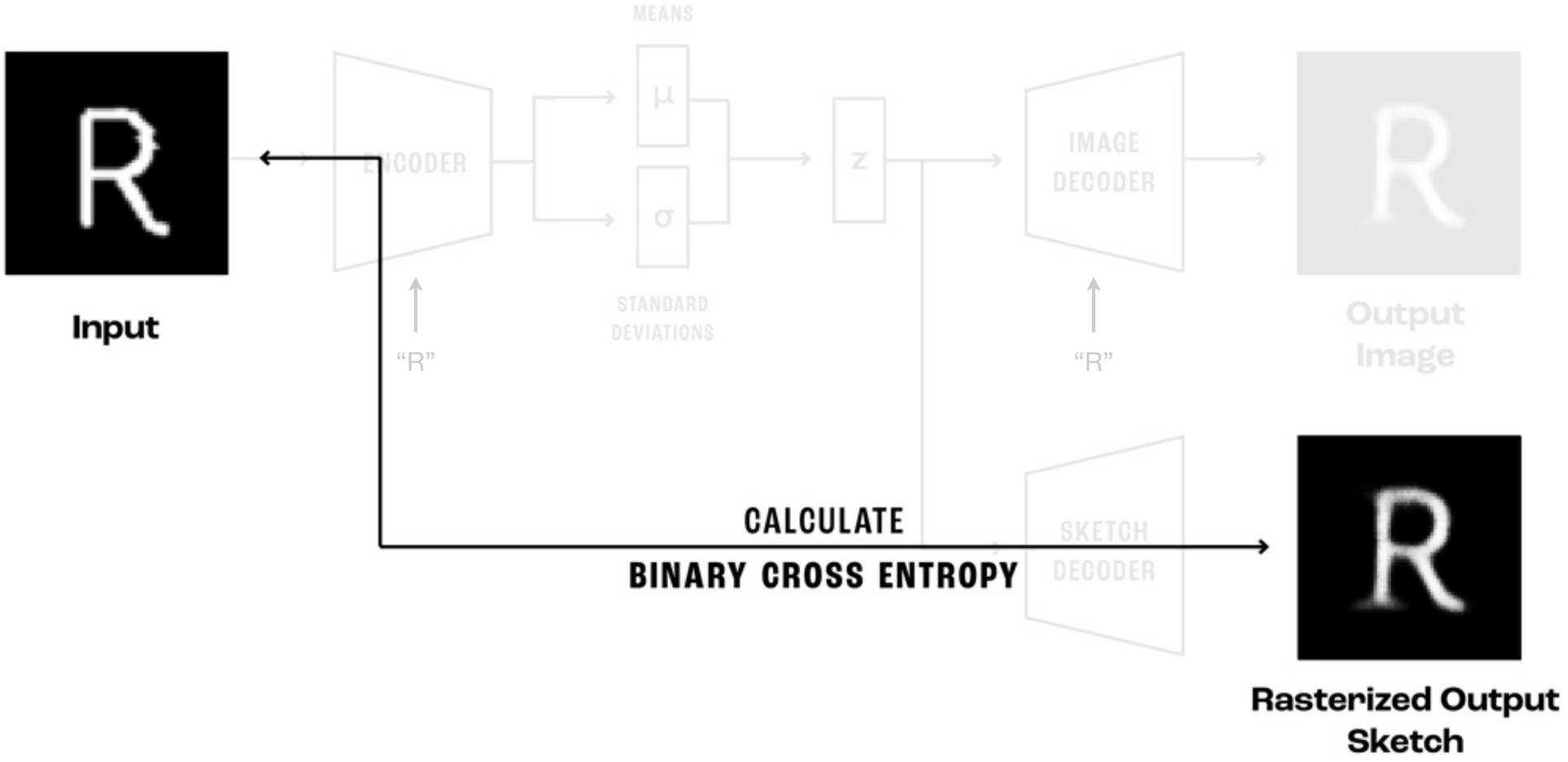
"R"
Output Image
SKETCH DECODER
Output Sketch



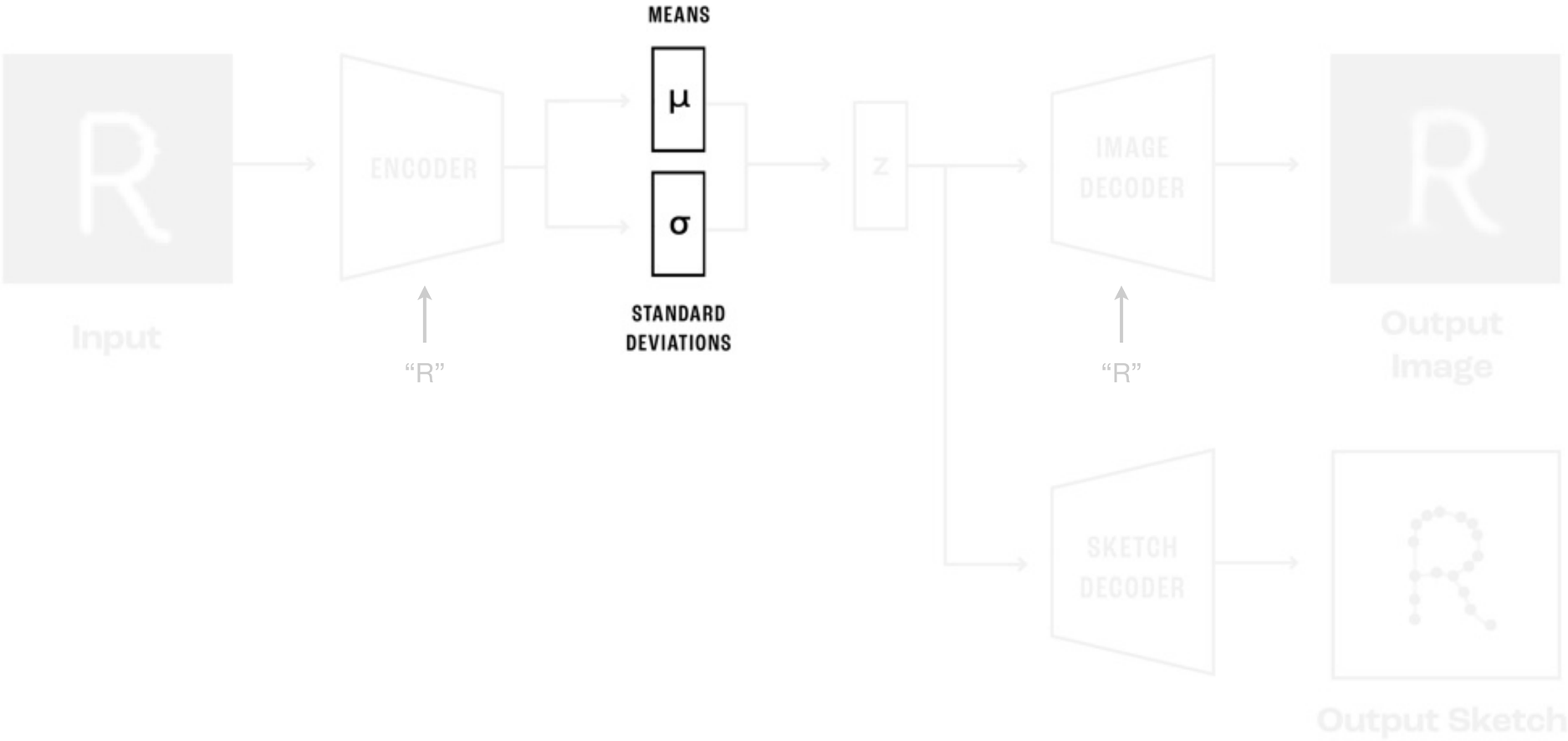
NETWORK ARCHITECTURE OF VAE — Loss Function



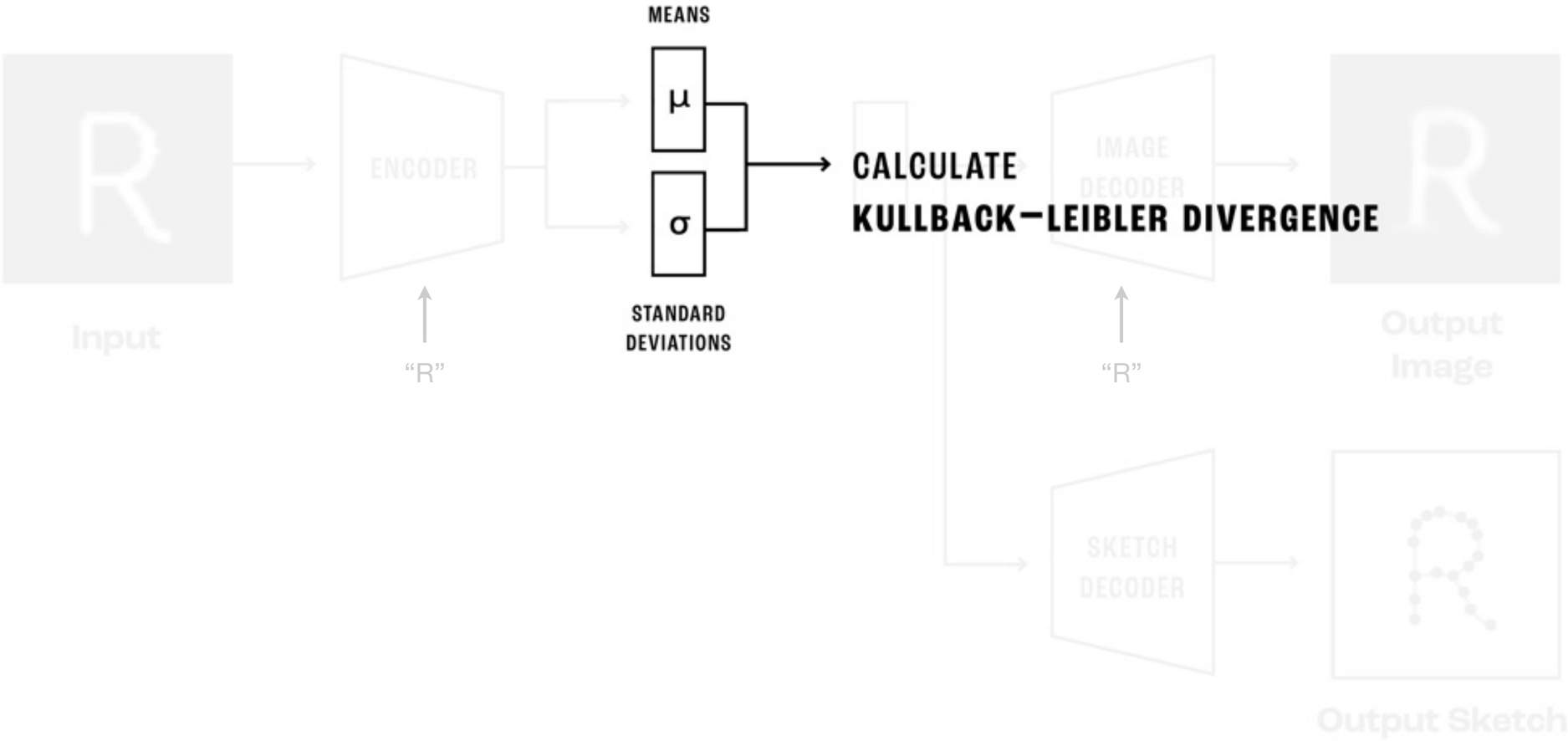
NETWORK ARCHITECTURE OF VAE — Loss Function



NETWORK ARCHITECTURE OF VAE — Loss Function



NETWORK ARCHITECTURE OF VAE — Loss Function



NETWORK ARCHITECTURE OF VAE — Loss Function

Loss Function

Loss Function

Binary Cross Entropy

Between the Input and Output Image

Loss Function

Binary Cross Entropy

Between the Input and Output Image

+

Binary Cross Entropy

Between the Input Image and the Rasterized Output Sketch

Loss Function

Binary Cross Entropy

Between the Input and Output Image

+

Binary Cross Entropy

Between the Input Image and the Rasterized Output Sketch

+

Kullback–Leibler Divergence

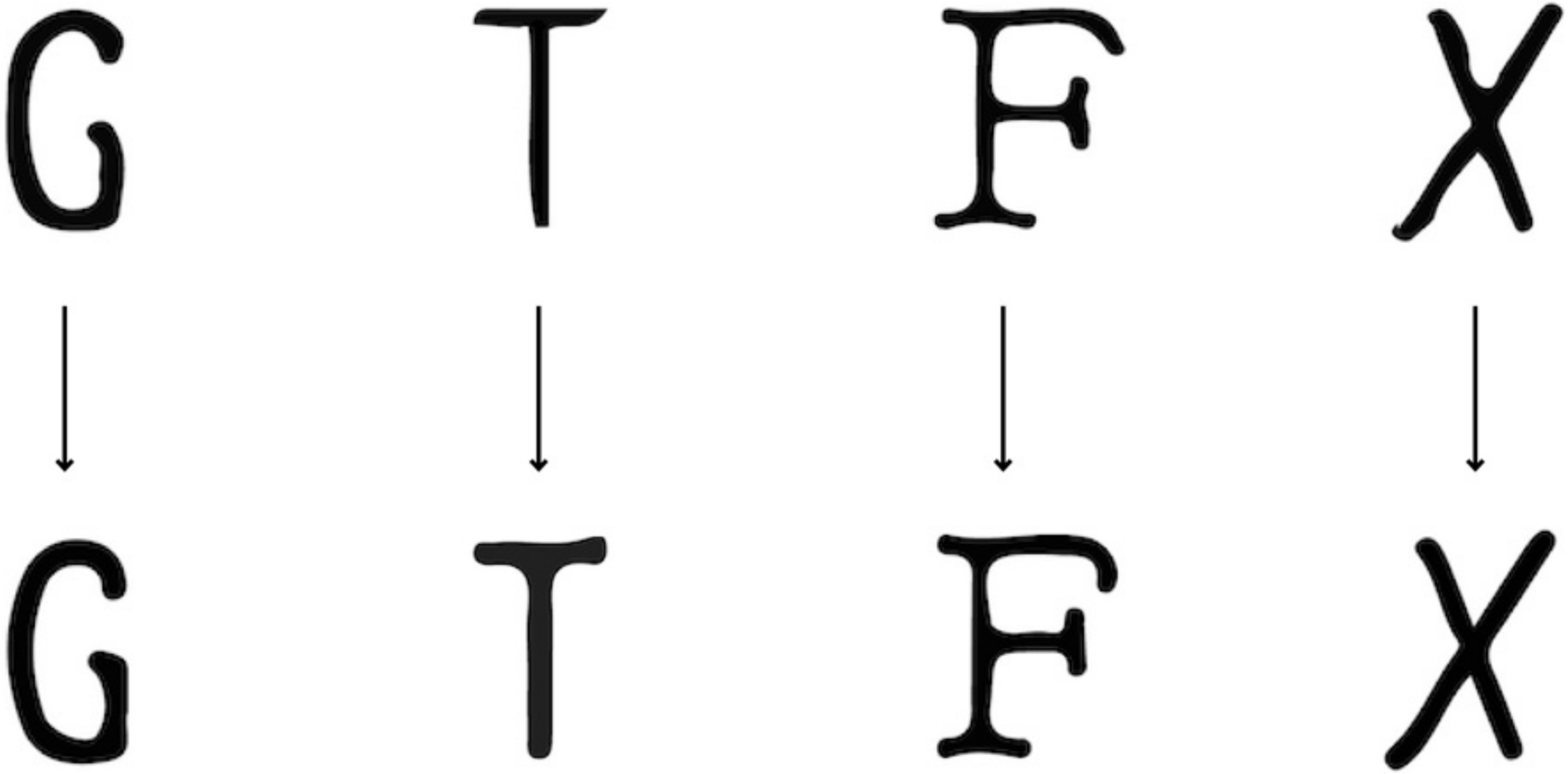
On the Mean and Standard Deviation

Results

VAE and Sketch Decoder were trained for **50 epochs,**
with a **learning rate of 0.001** and a **batch size of 256.**

Results

I. Reconstruct skeletons



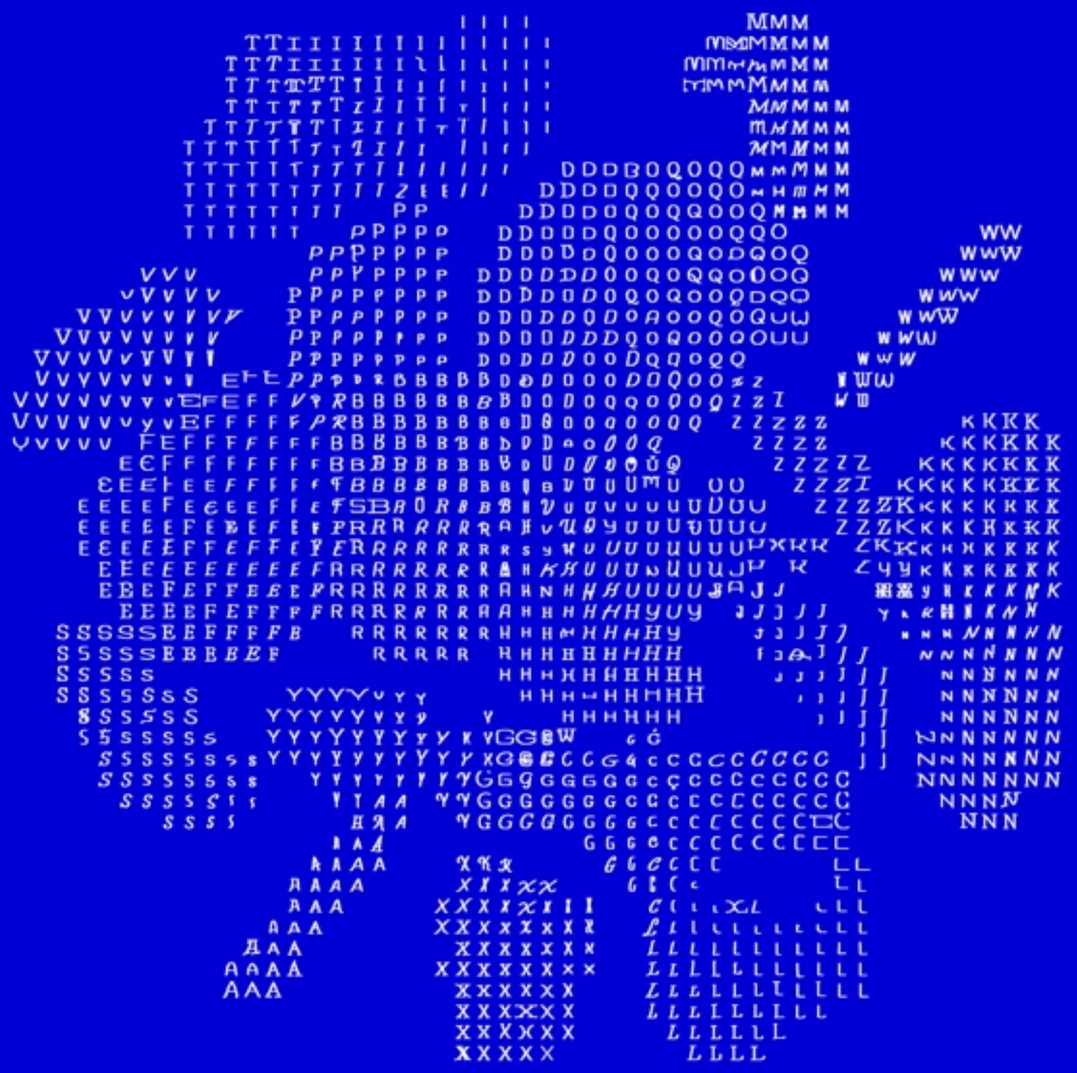
RESULTS — Reconstruct Skeletons

RESULTS — Reconstruct Skeletons

Results

II. Latent Space Representation of Font Style

CAPTION
t-SNE visualisation of the learned latent space z for all the capital letters of the Latin alphabet.



RESULTS — Latent Space Representation of Font Style

CAPTION
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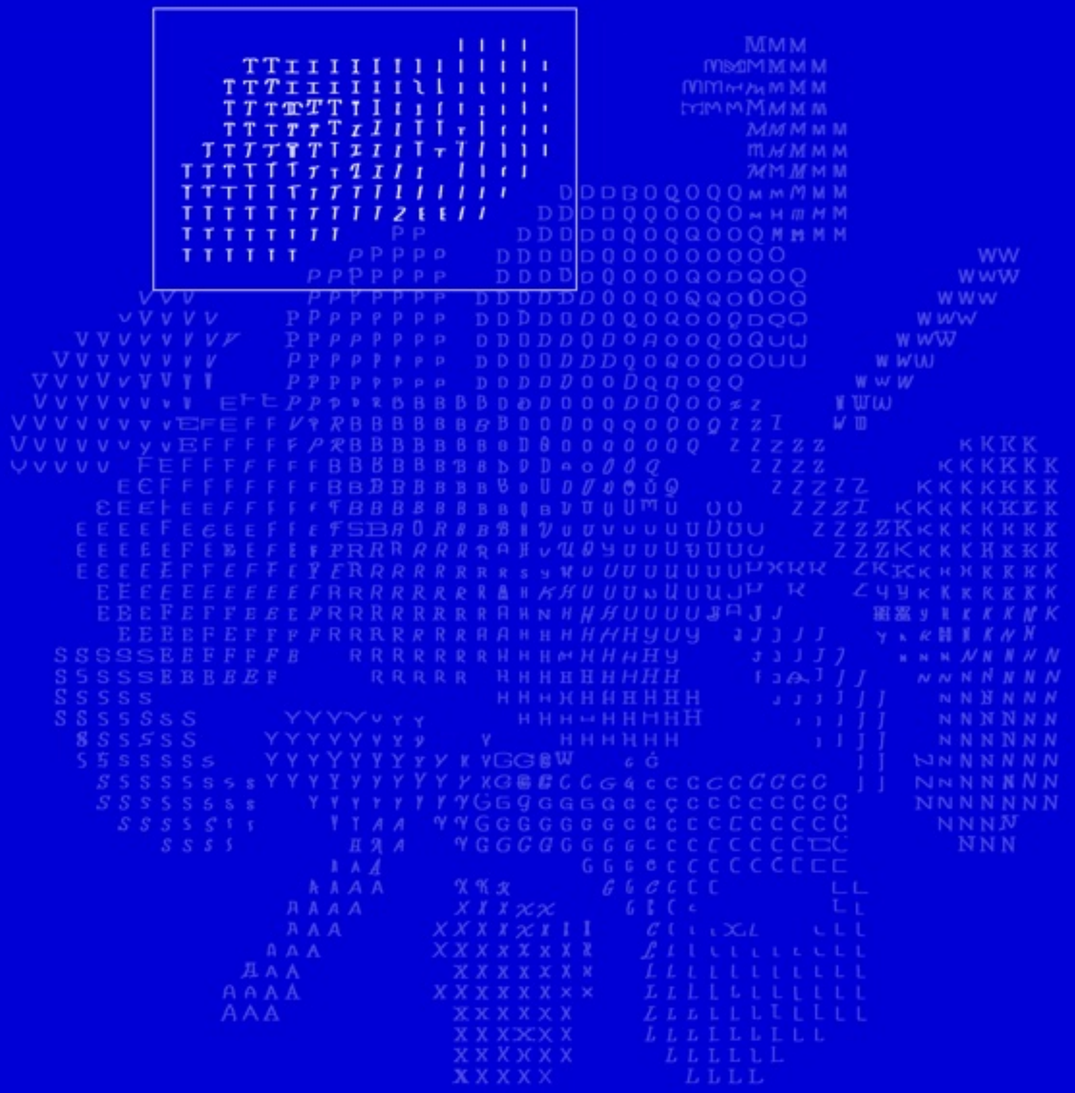

RESULTS — Latent Space Representation of Font Style

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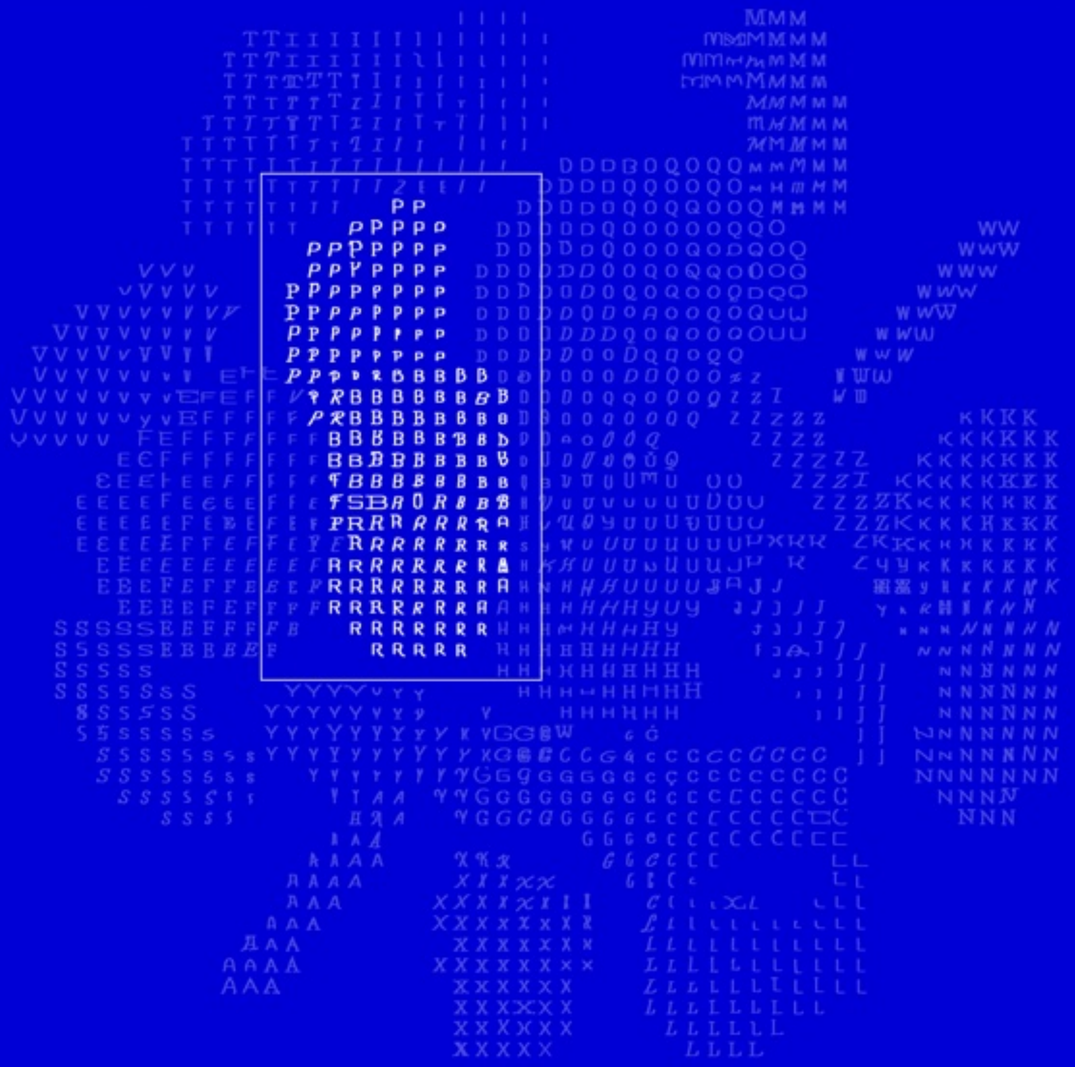
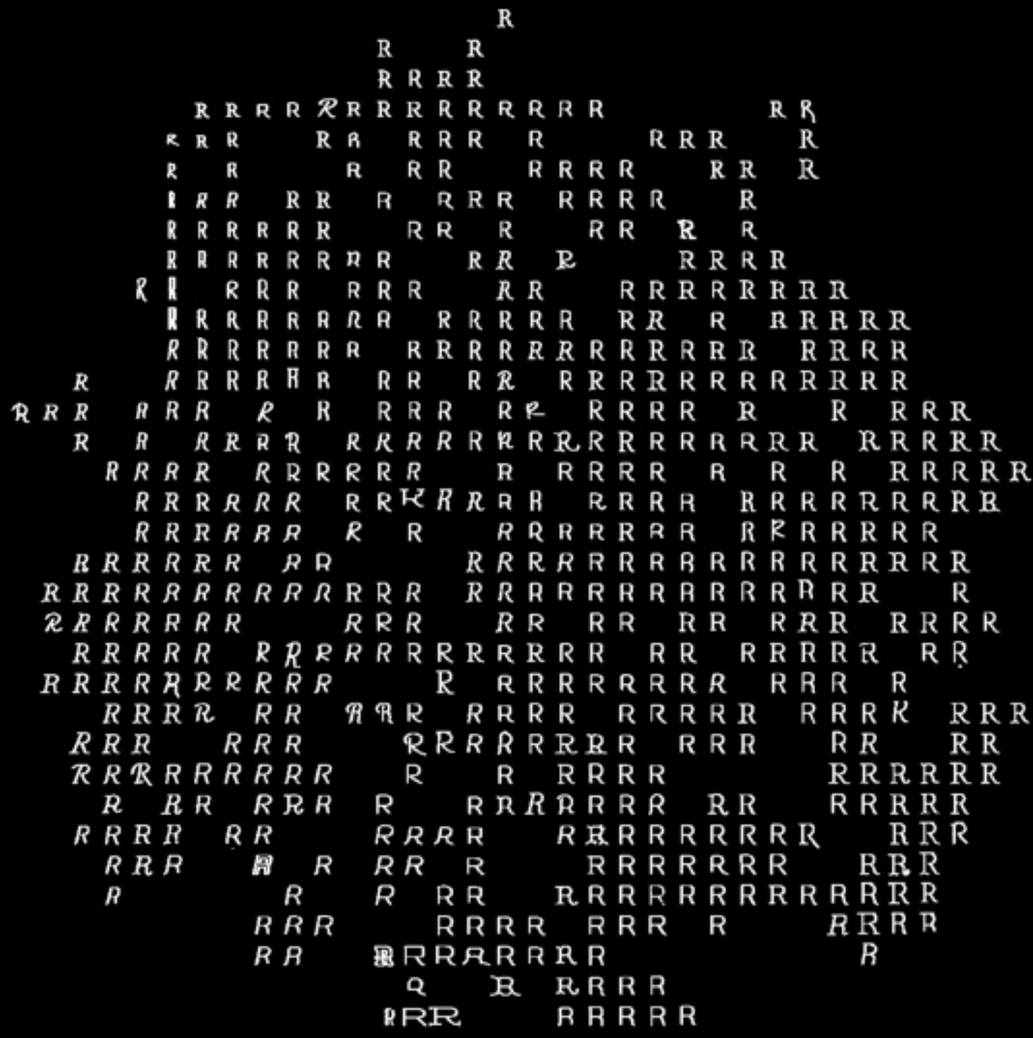


RESULTS — Latent Space Representation of Font Style

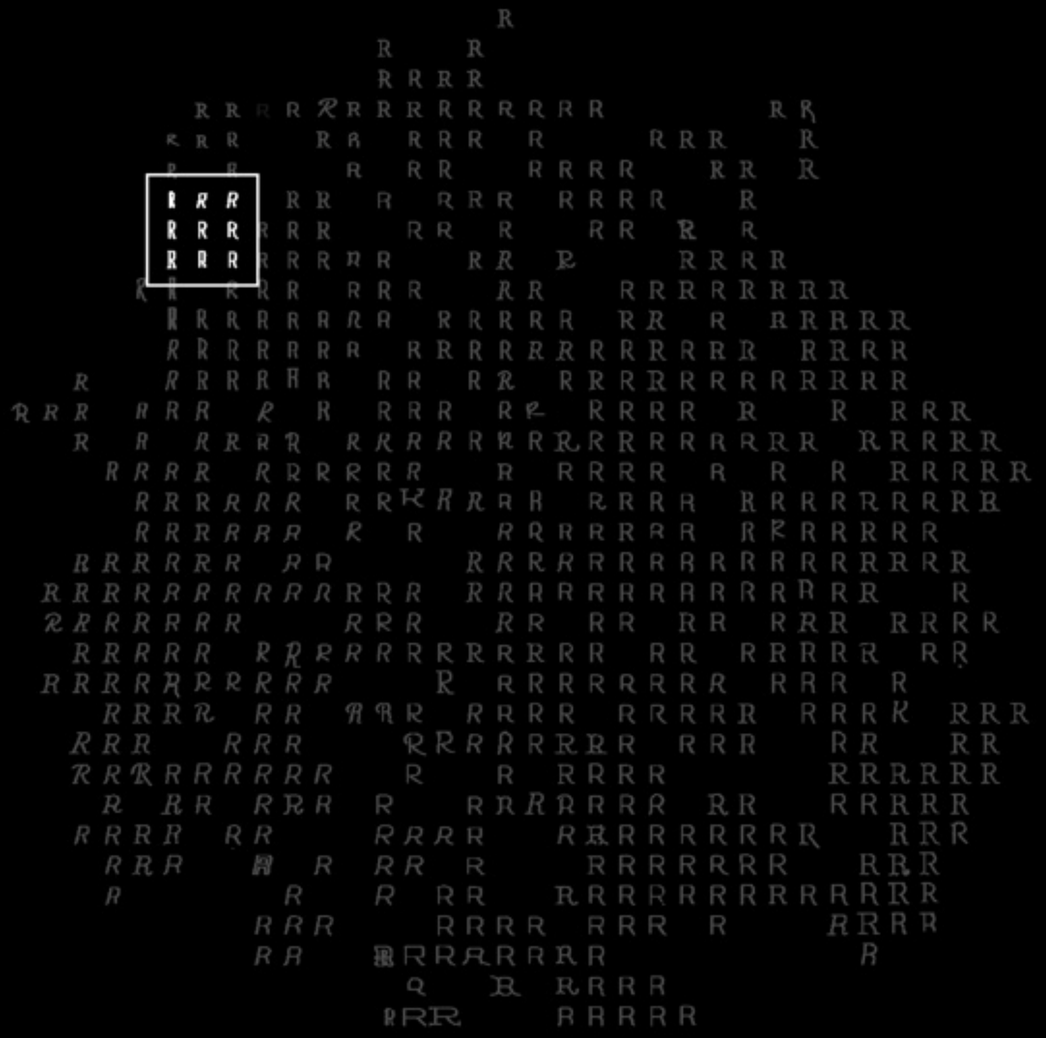
CAPTION
t-SNE visualisation of the learned latent space z for all the capital letters of the Latin alphabet.

RESULTS — Latent Space Representation of Font Style



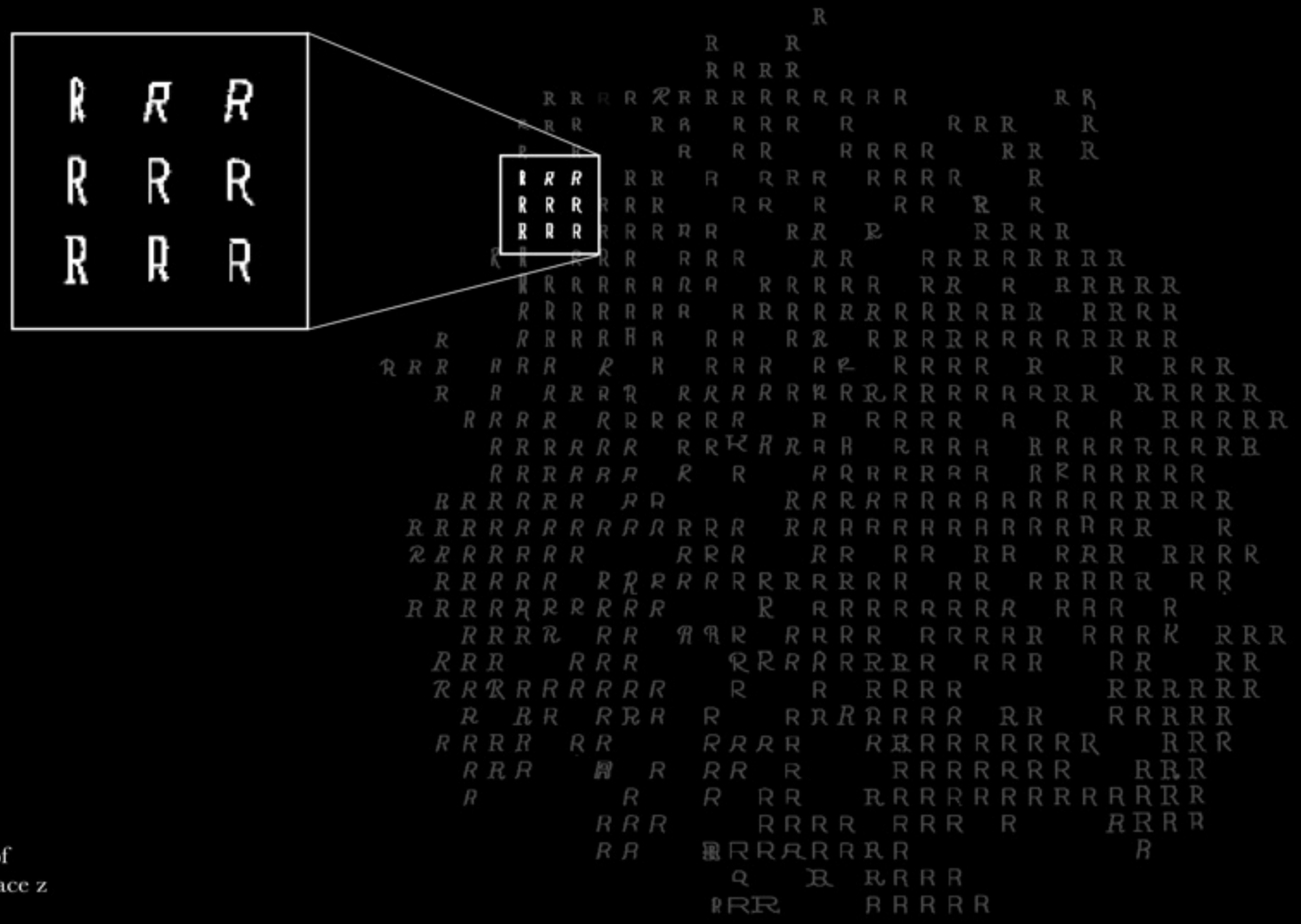
CAPTION
t-SNE visualisation of the learned latent space z for the letter "R".

RESULTS — Latent Space Representation of Font Style



CAPTION
t-SNE visualisation of the learned latent space z for the letter "R".

RESULTS — Latent Space Representation of Font Style



CAPTION
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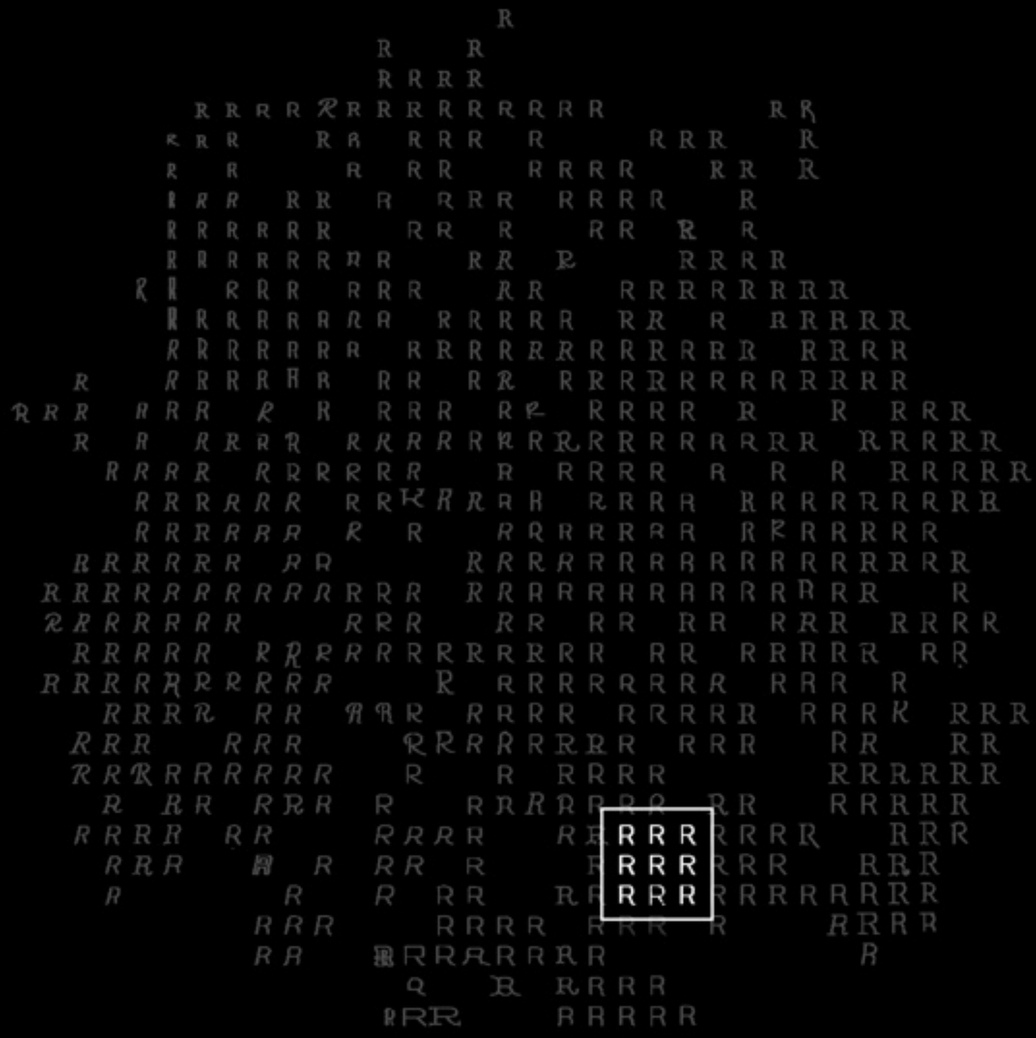
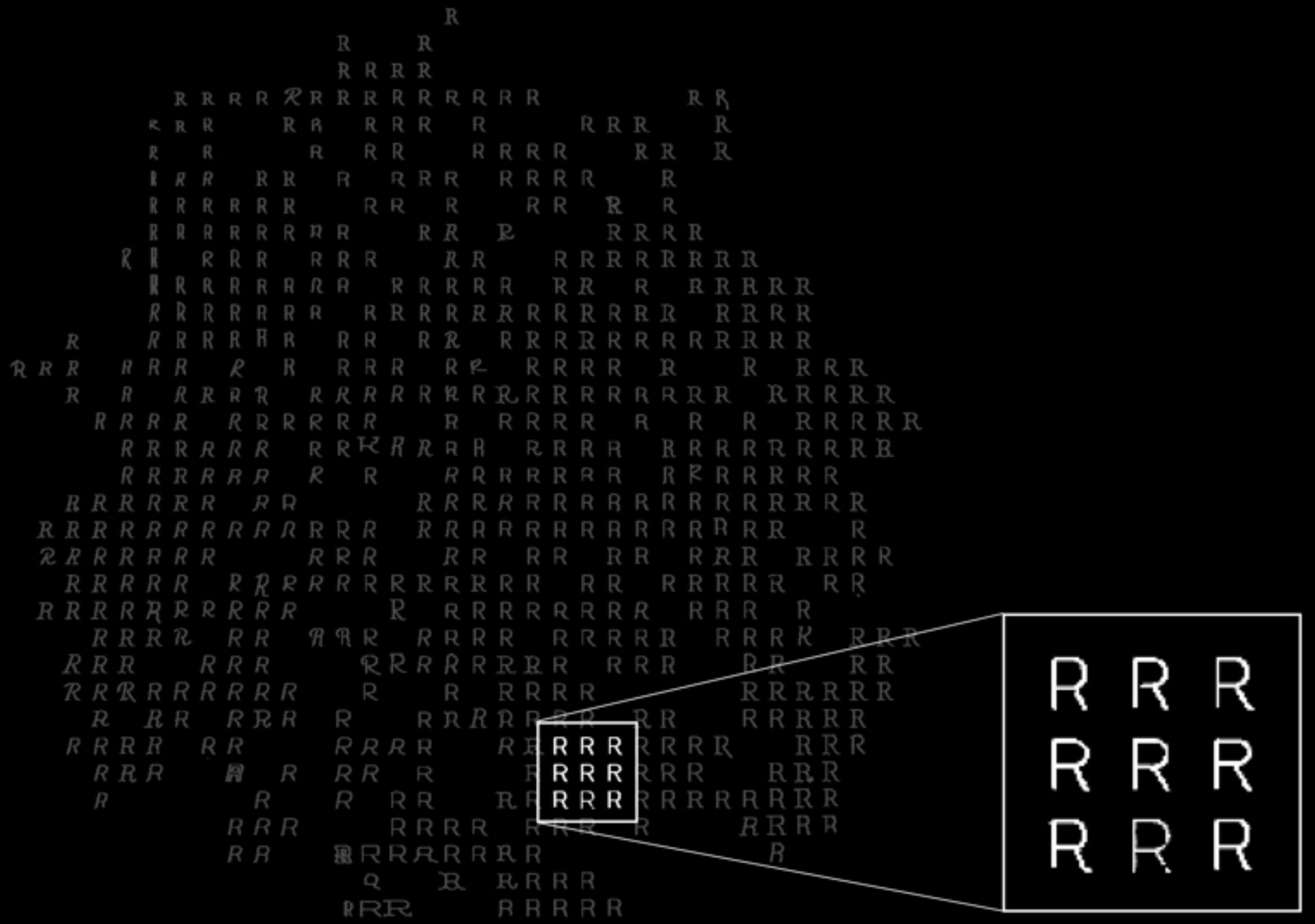
the learned latent space z
for the letter "R".

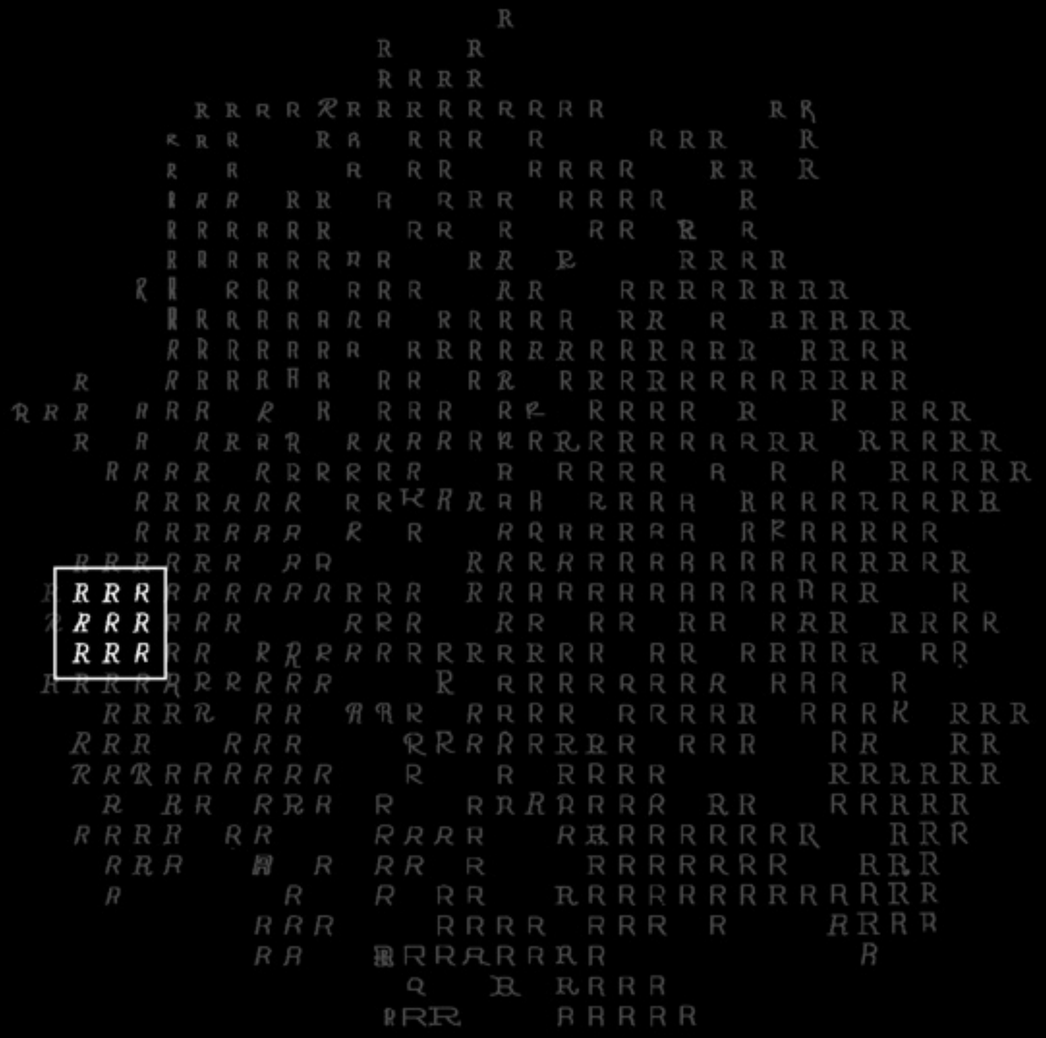


CAPTION
t-SNE visualisation of the learned latent space z for the letter "R".

RESULTS — Latent Space Representation of Font Style



CAPTION
t-SNE visualisation of the learned latent space z for the letter "R".



CAPTION
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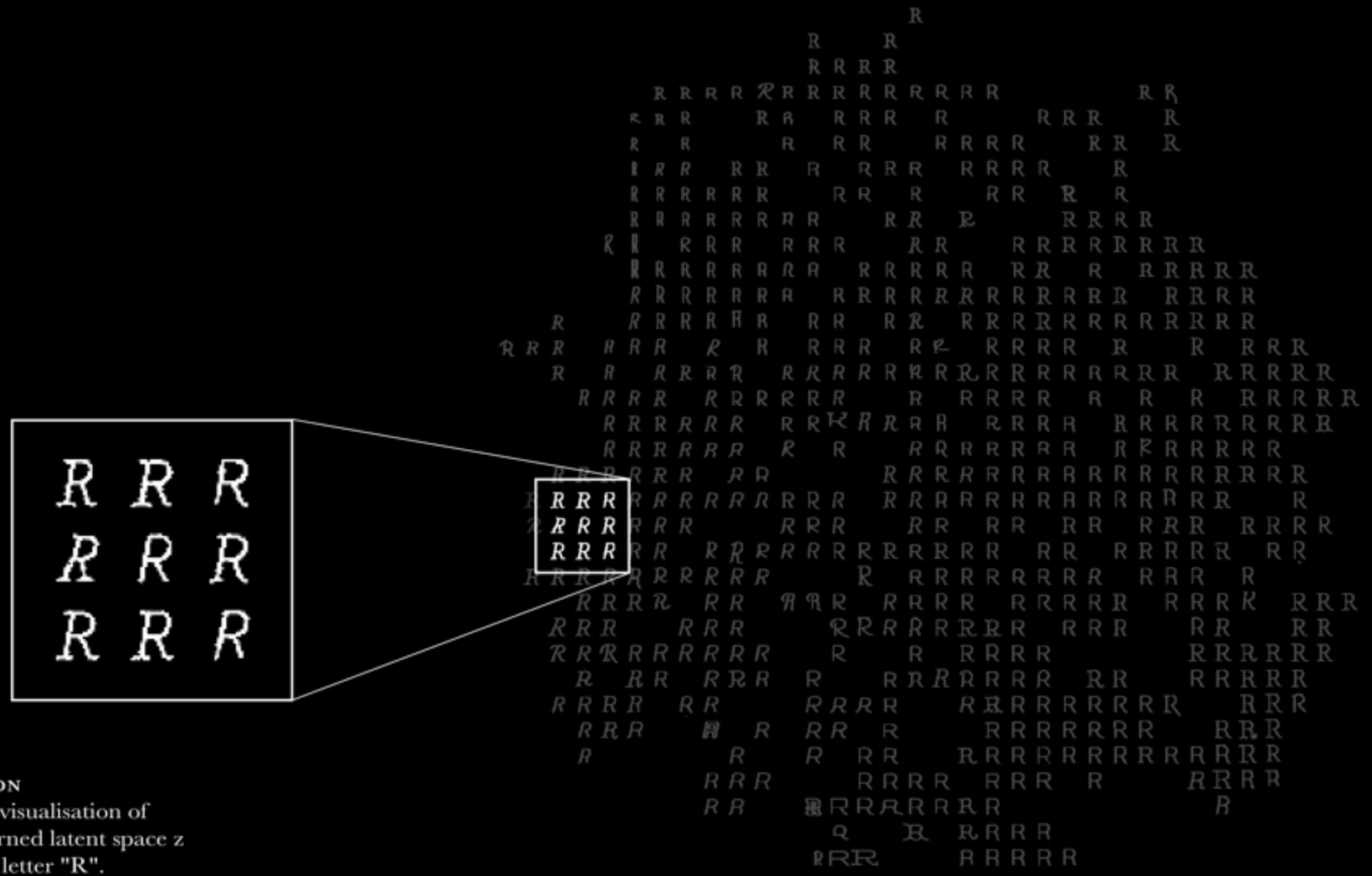
the learned latent space z
for the letter "R".



CAPTION
t-SNE visualisation of
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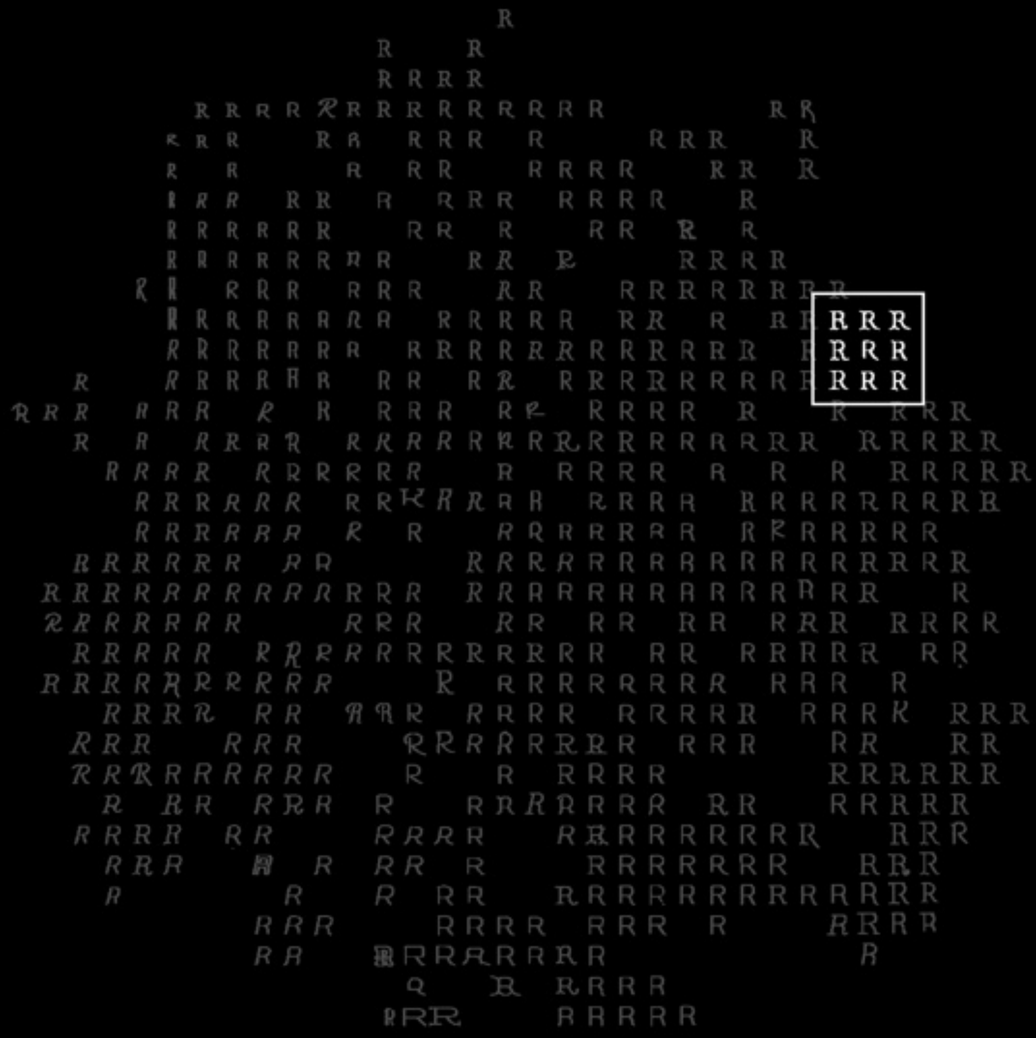
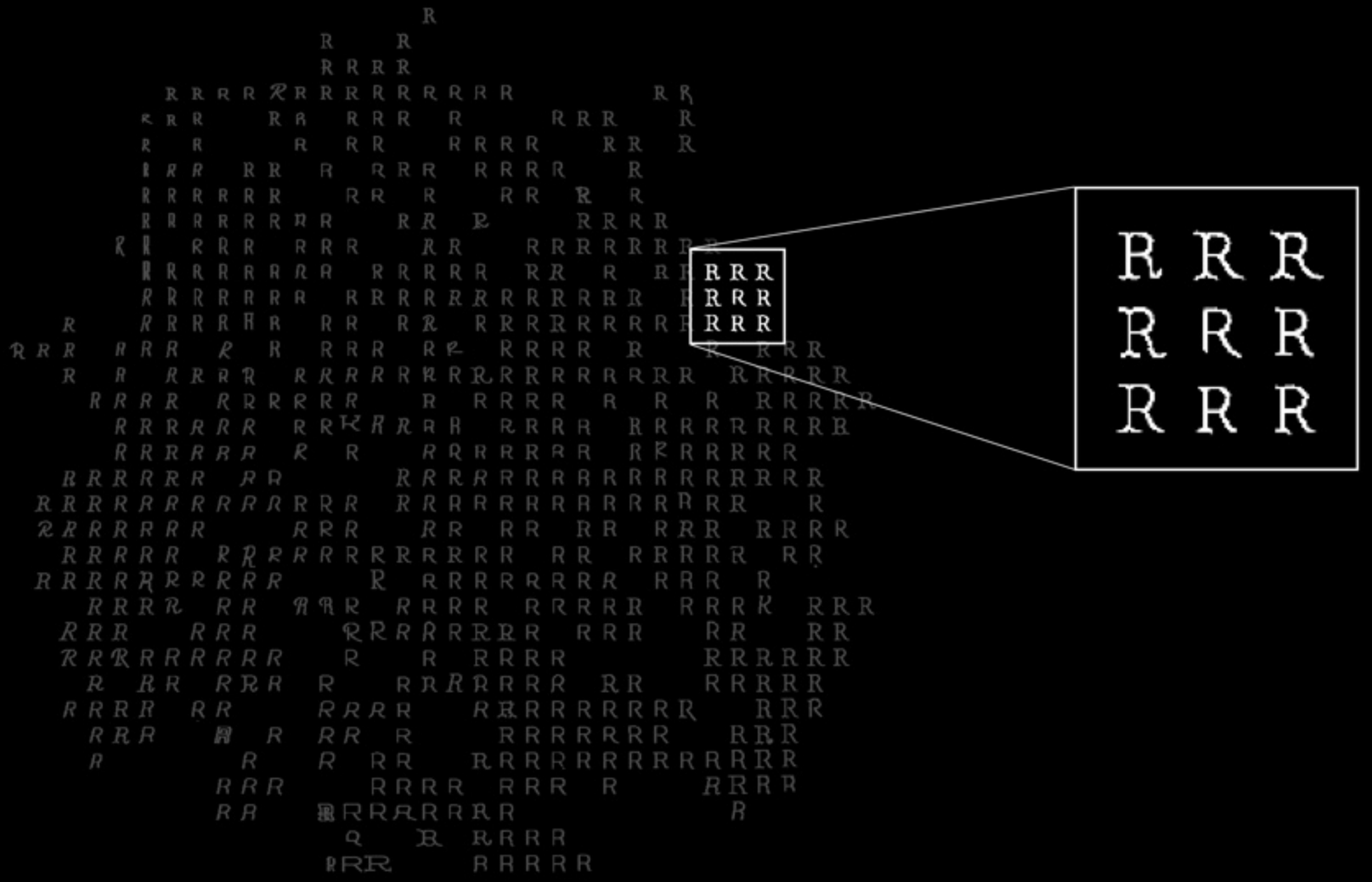
for the letter "R".

RESULTS — Latent Space Representation of Font Style

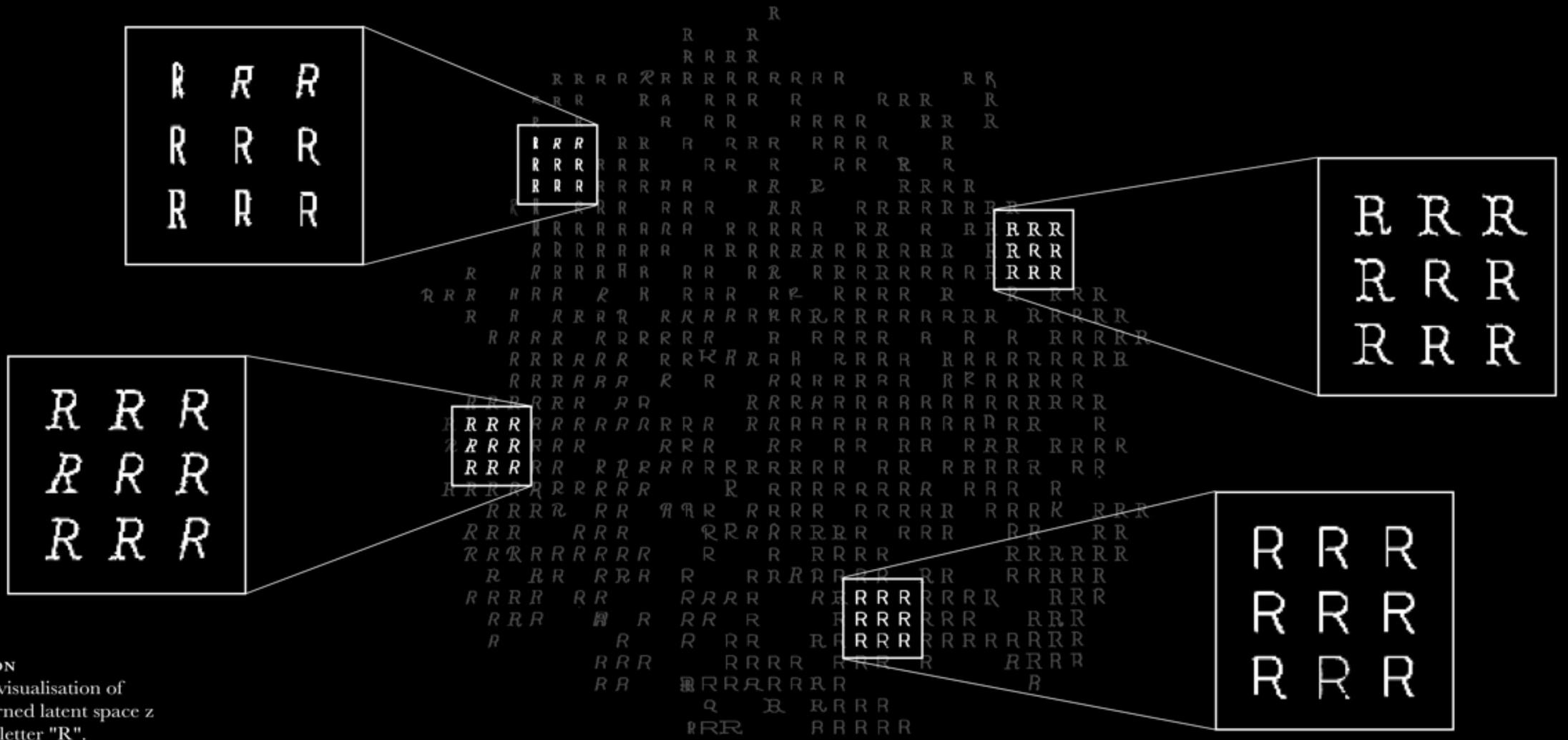


CAPTION
t-SNE visualisation of the learned latent space z for the letter "R".



CAPTION
t-SNE visualisation of the learned latent space z for the letter "R".

RESULTS — Latent Space Representation of Font Style

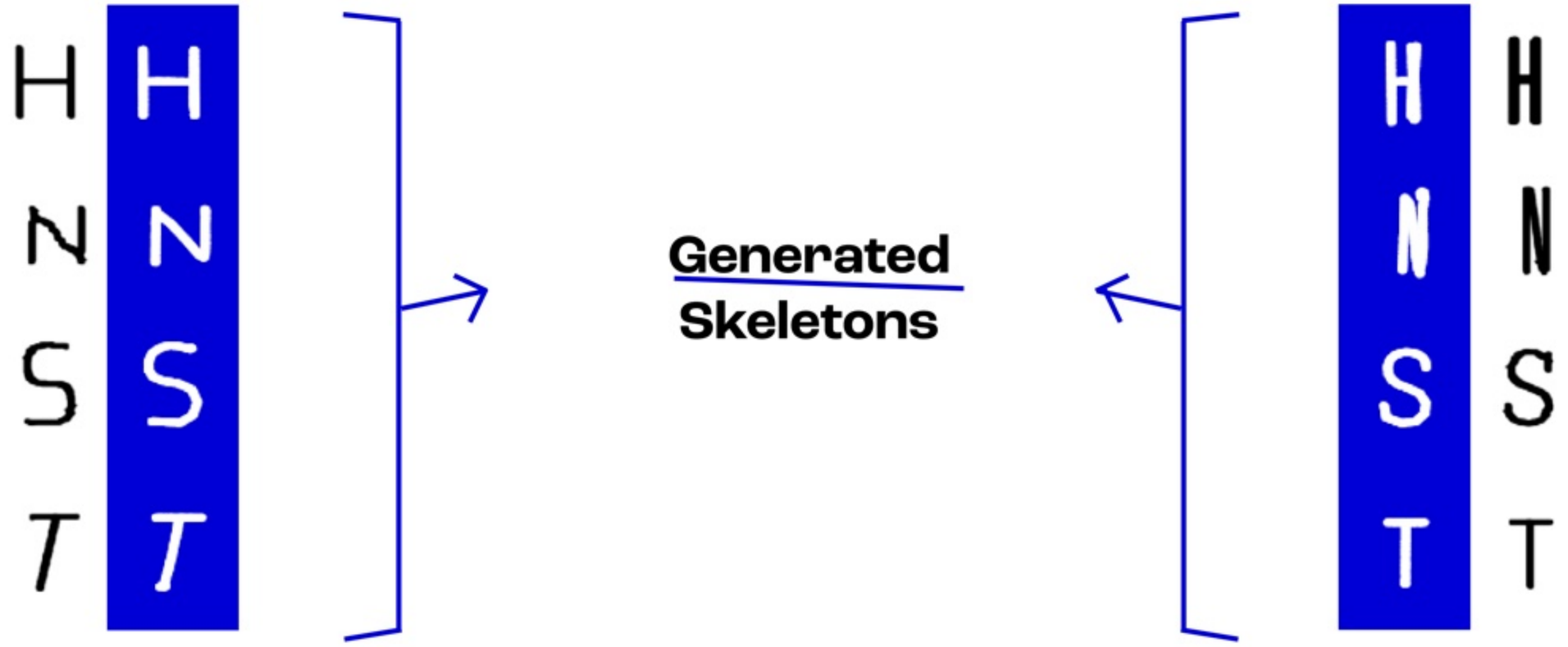


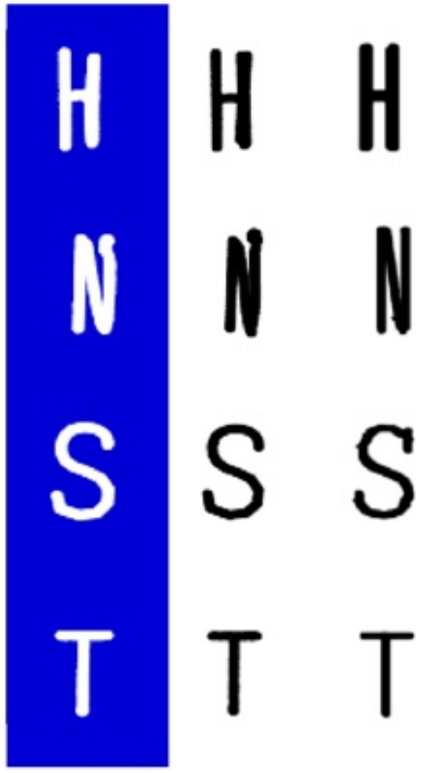
CAPTION
t-SNE visualisation of
the learned latent space z
for the letter "R".

Results

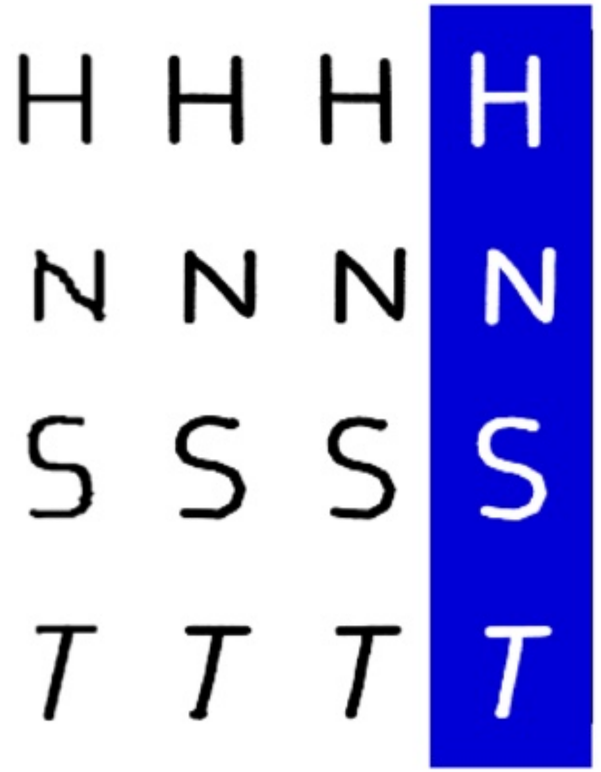
III. Explore the Latent Space

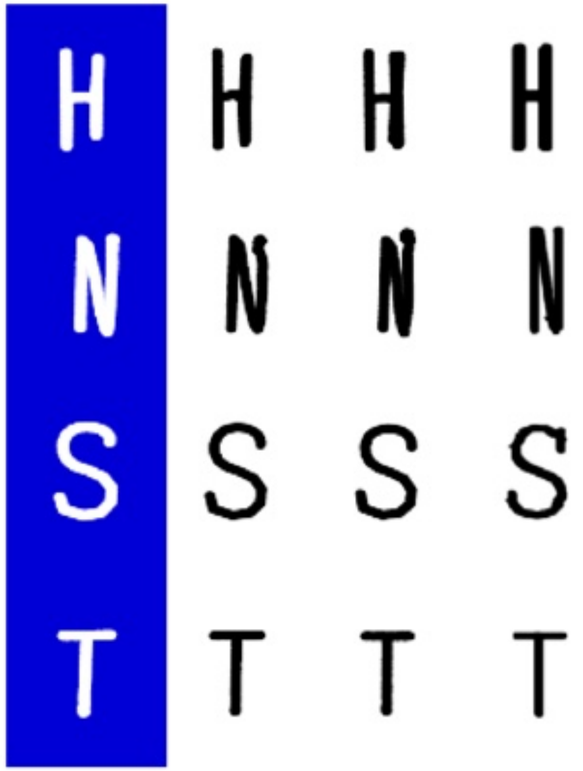

H
N
S
T
Reconstructed
Skeletons
H
N
S
T


Generated
Skeletons

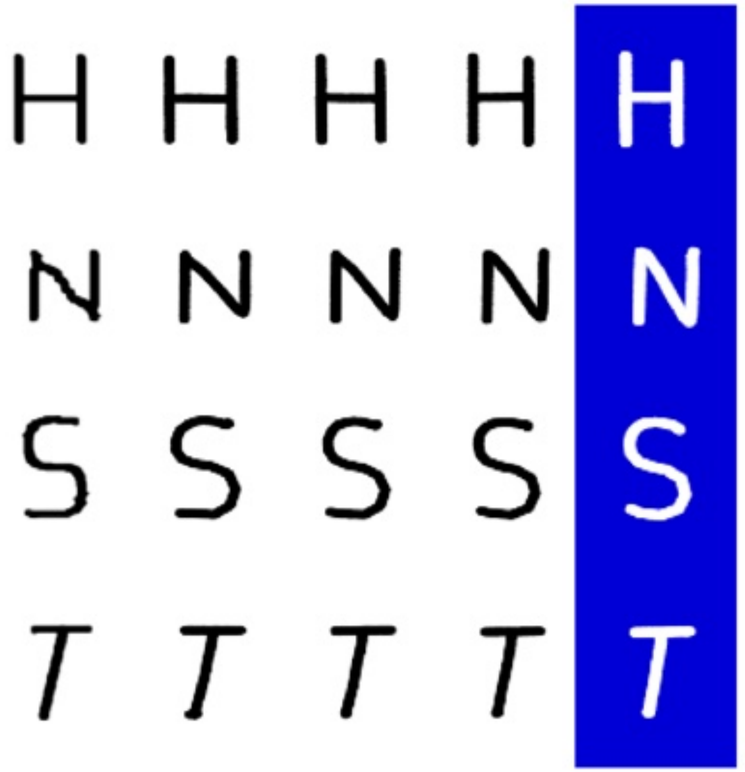


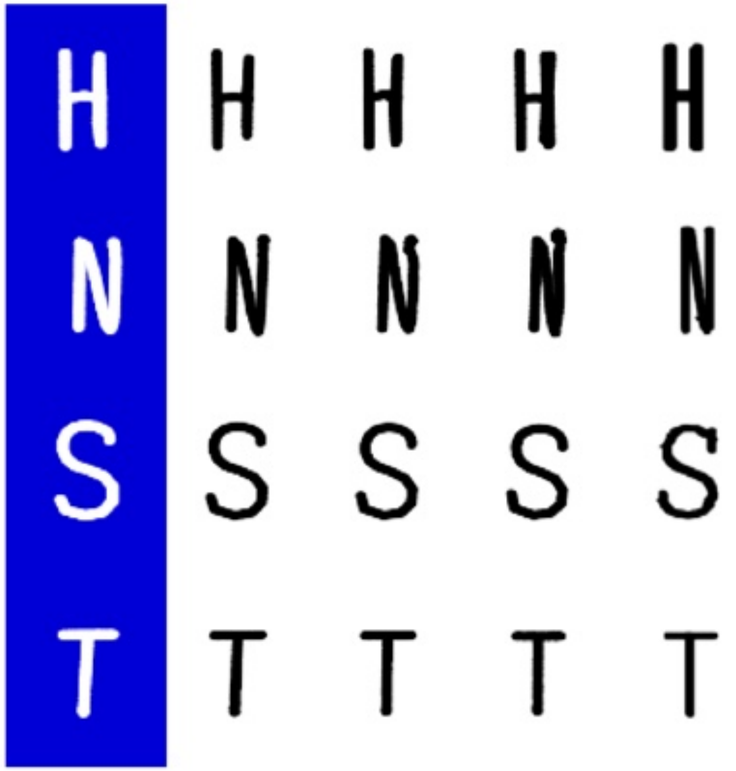
RESULTS — Explore the Latent Space

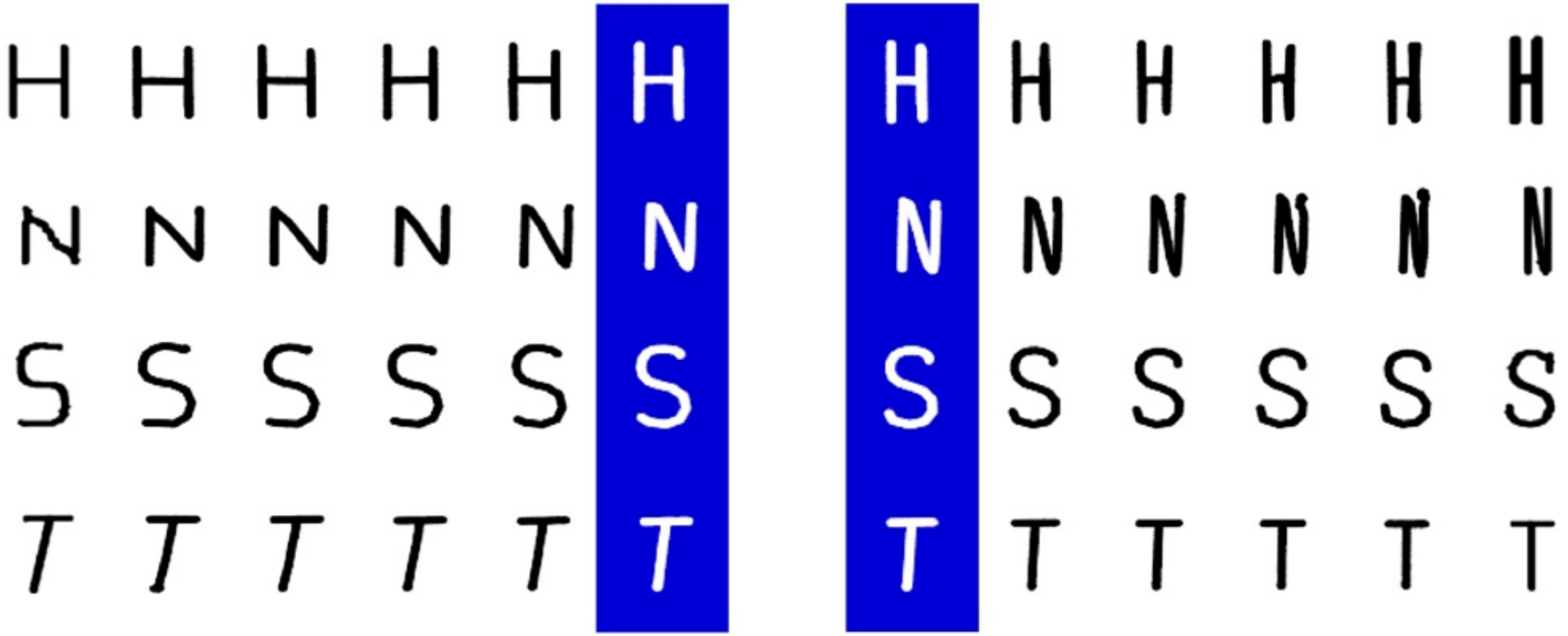




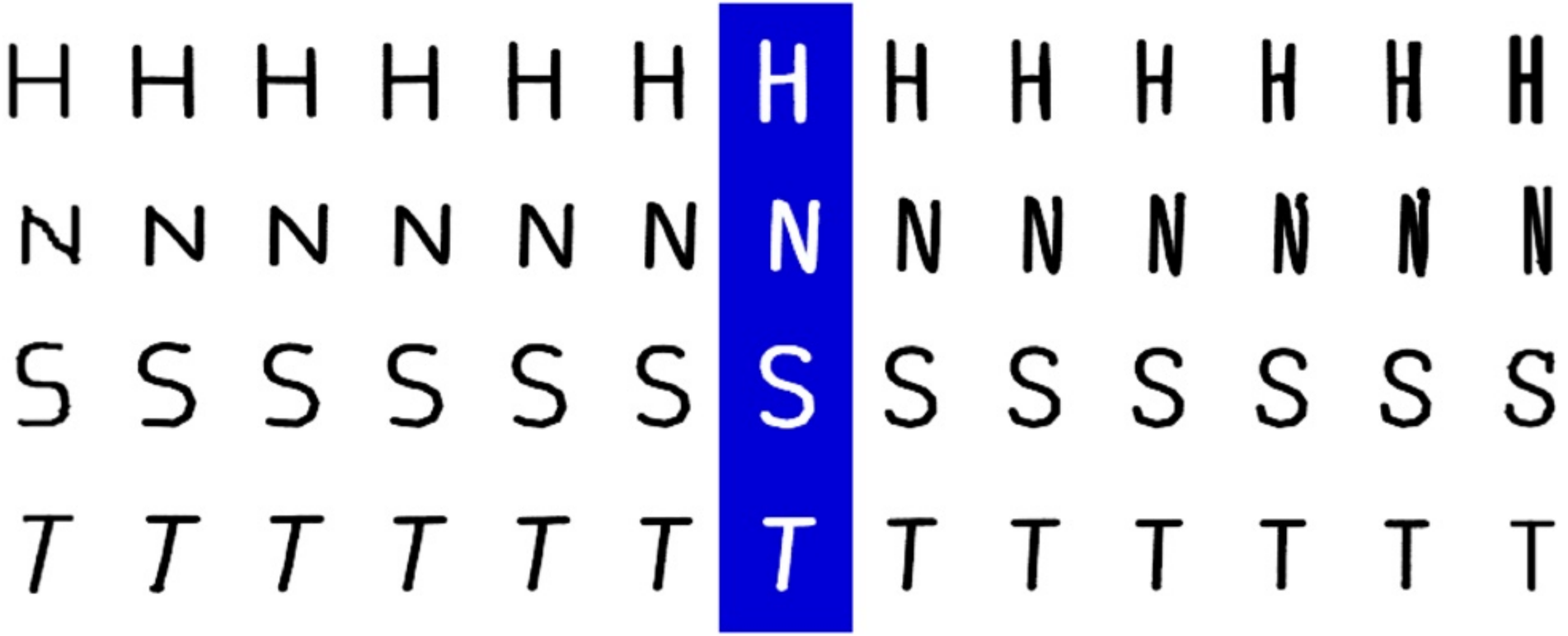
RESULTS — Explore the Latent Space



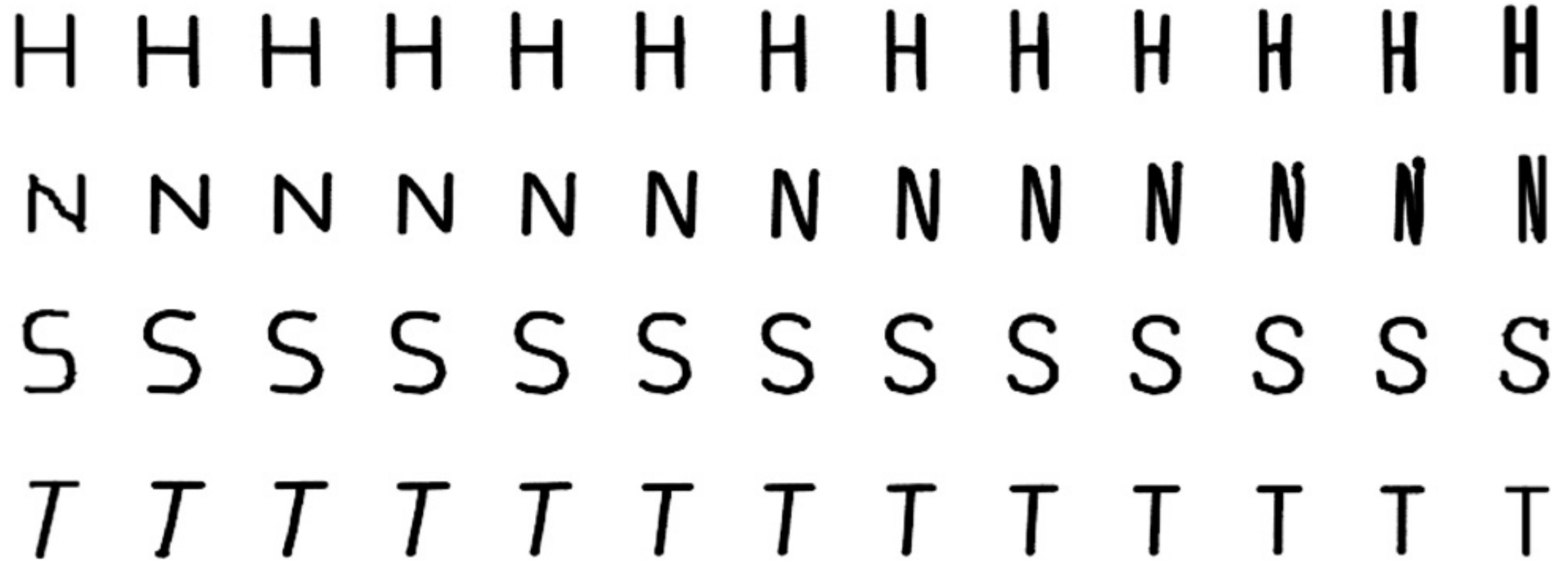




RESULTS — Explore the Latent Space



RESULTS — Explore the Latent Space

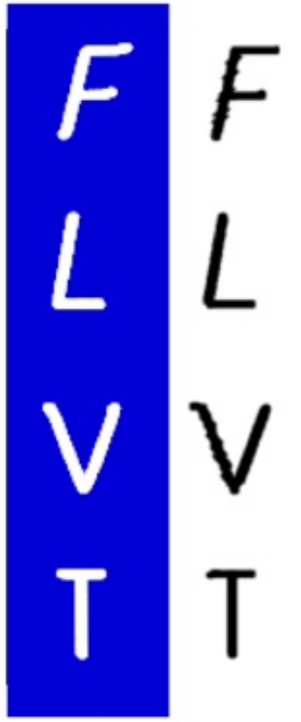


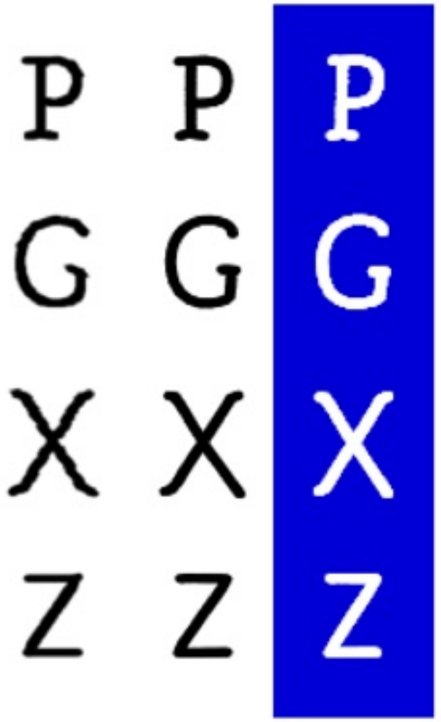
RESULTS — Explore the Latent Space

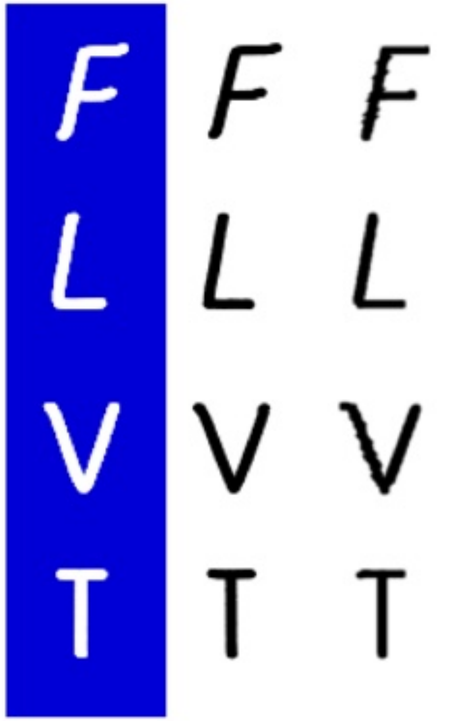
RESULTS — Explore the Latent Space

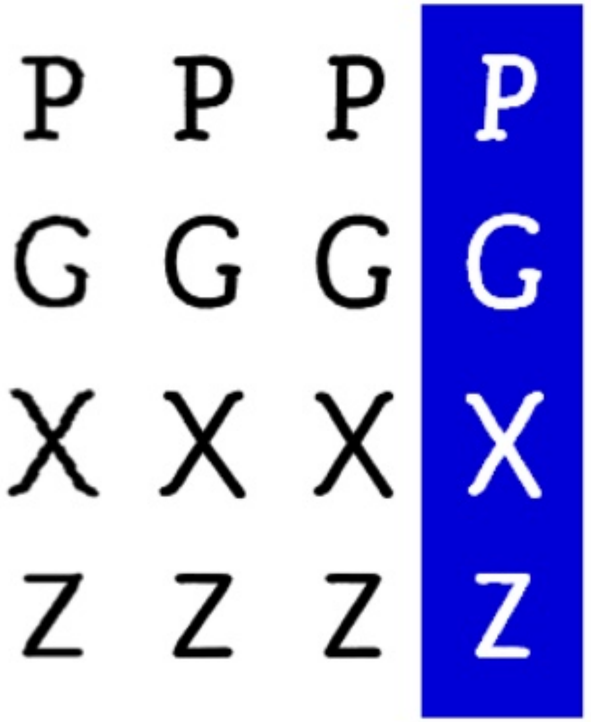
RESULTS — Explore the Latent Space

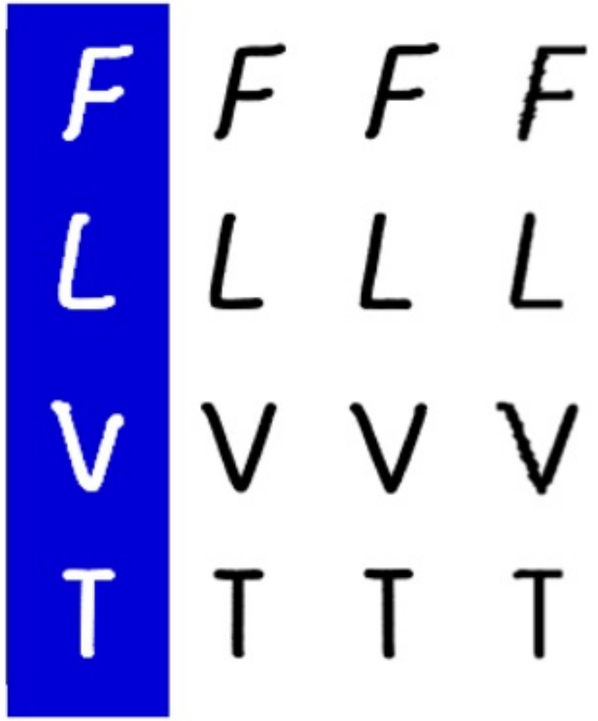

P
G
X
Z
P
G
X
Z


F
L
V
T
F
L
V
T

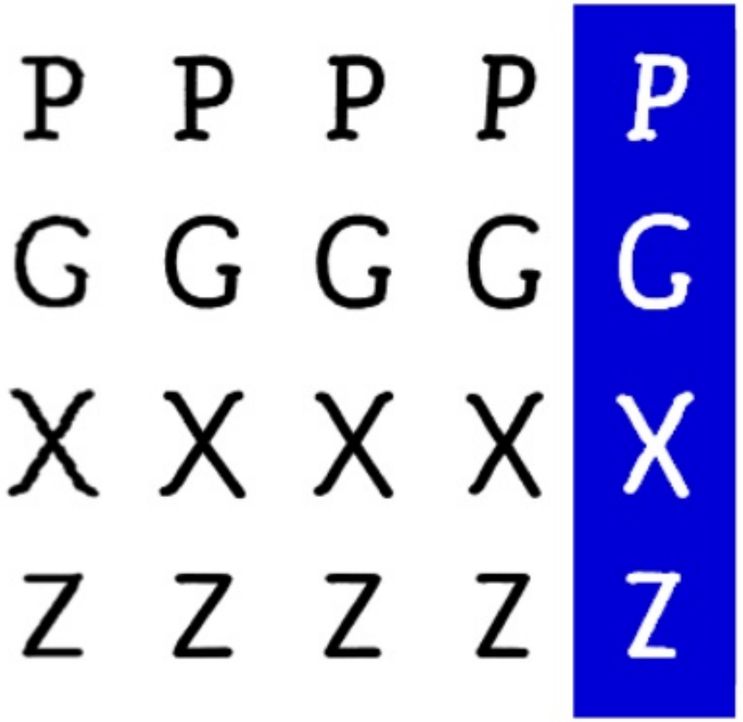

P P P
G G G
X X X
Z Z Z

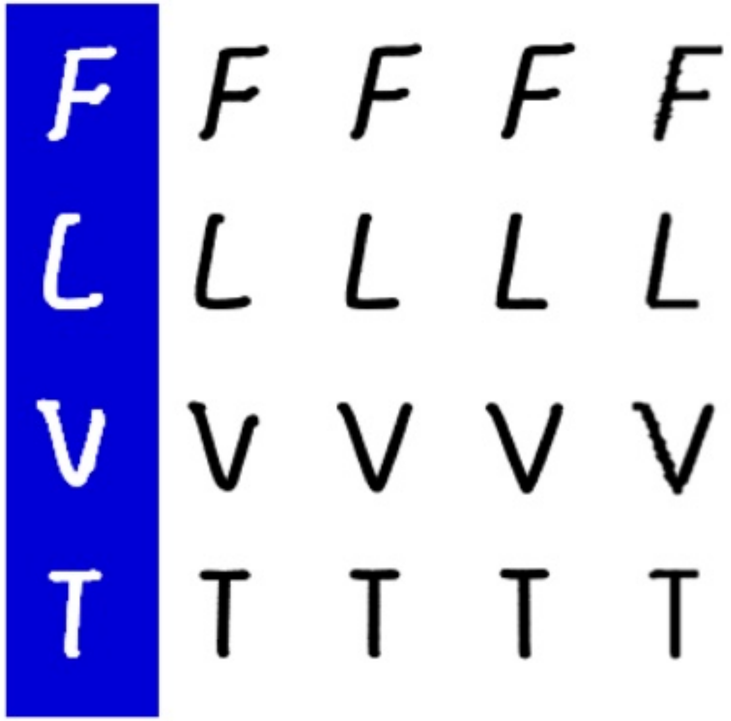

F F F
L L L
V V V
T T T



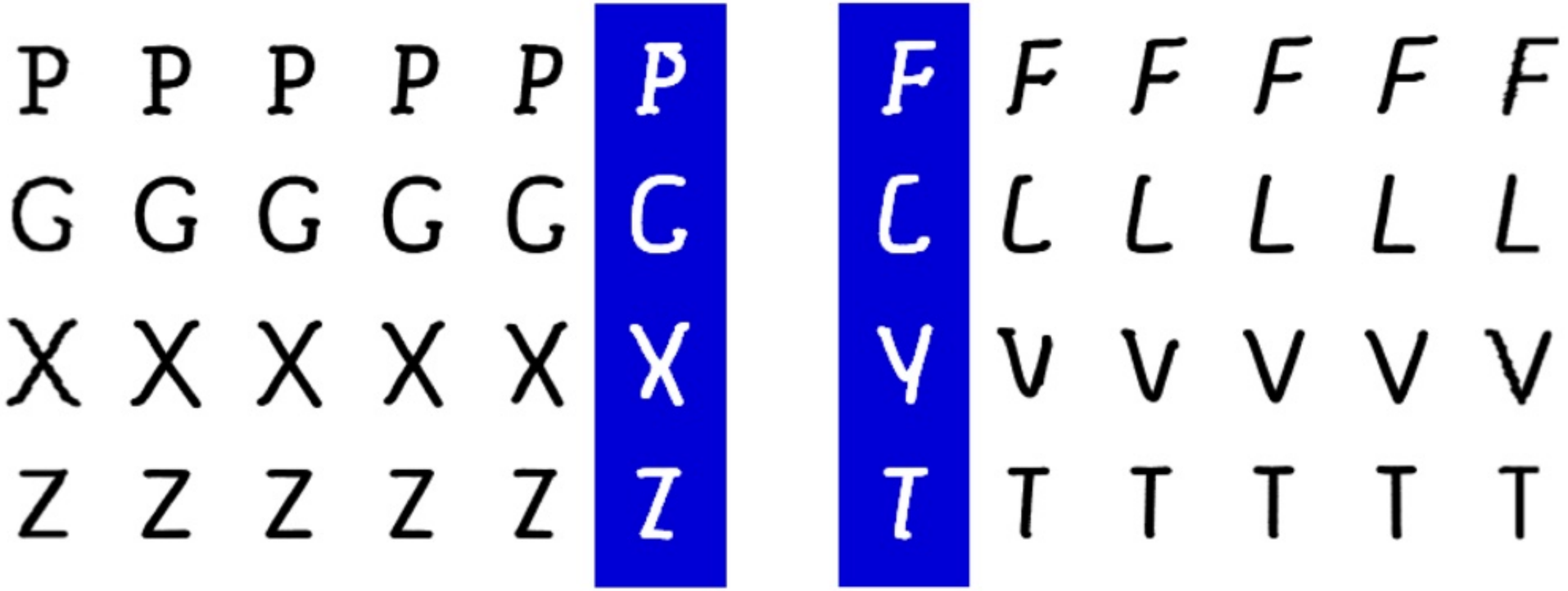


RESULTS — Explore the Latent Space

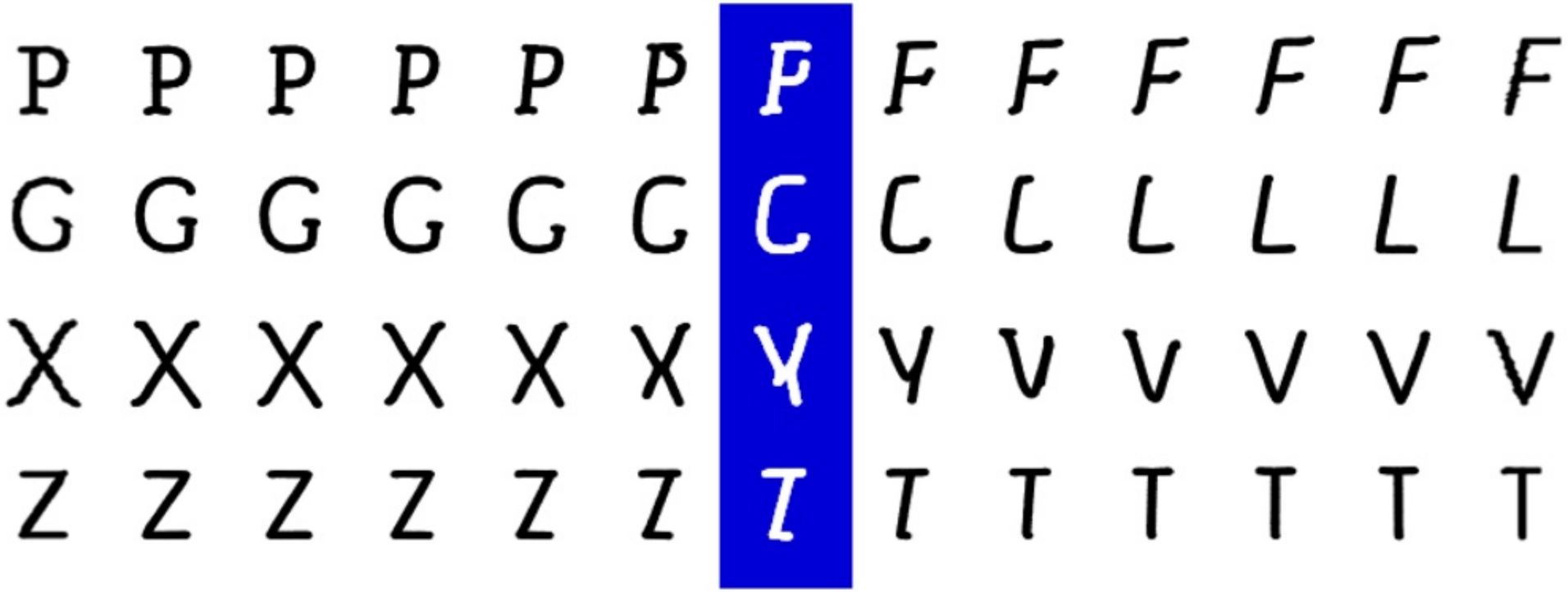




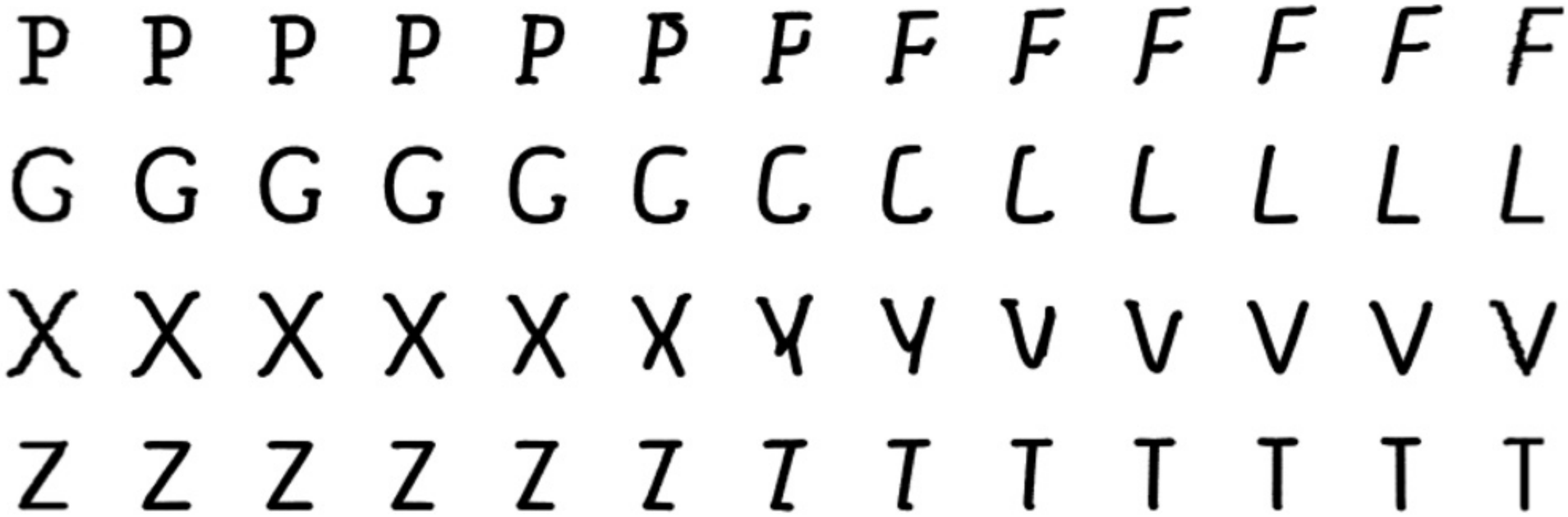
RESULTS — Explore the Latent Space



RESULTS — Explore the Latent Space



RESULTS — Explore the Latent Space



RESULTS — Explore the Latent Space

RESULTS — Explore the Latent Space

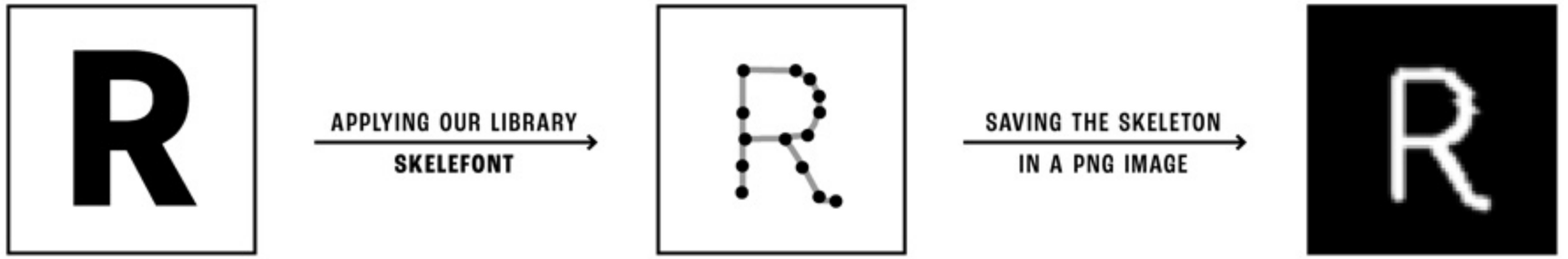
RESULTS — Explore the Latent Space

Results

IV. Transform Skeletons into Glyphs

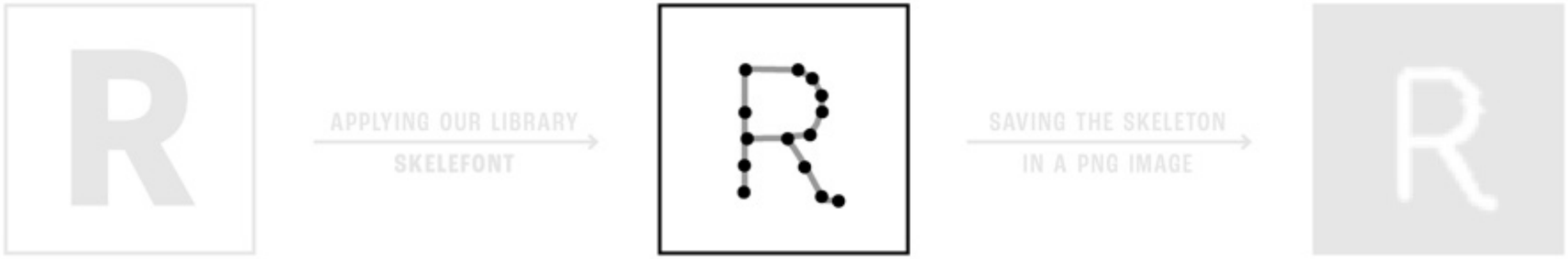
Results

IV. Transform Skeletons into Glyphs



A list of ordered:
point coordinates
and **stroke width**

RESULTS — Transform Skeletons into Glyphs



Input Glyph

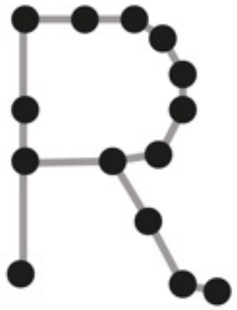
Extracted Skeleton

Input's Model

A list of ordered:
point coordinates
and **stroke width**

RESULTS — Transform Skeletons into Glyphs

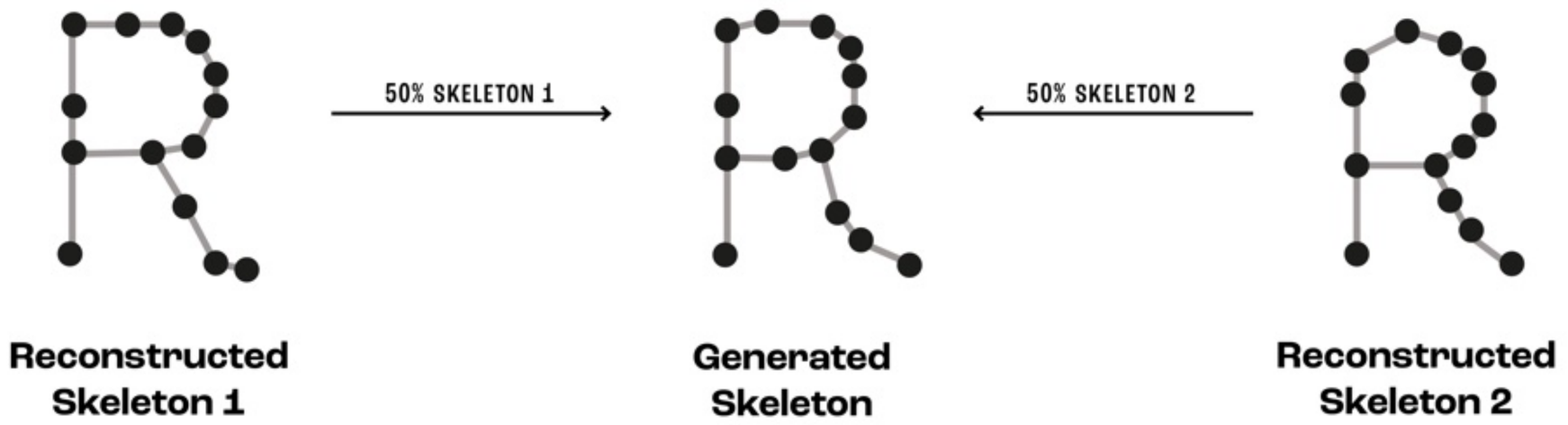
Select two **Reconstructed Skeletons**



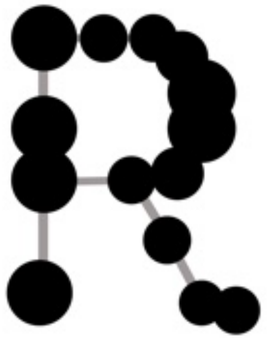
Reconstructed Skeleton 1

Reconstructed Skeleton 2

Create an **Blended Skeleton**



Add the **stroke width** in each point

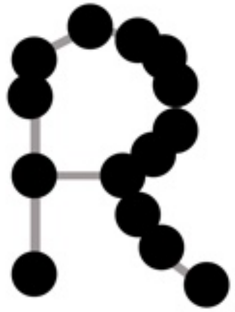


Reconstructed Skeleton 1

50% SKELETON 1

Generated Skeleton

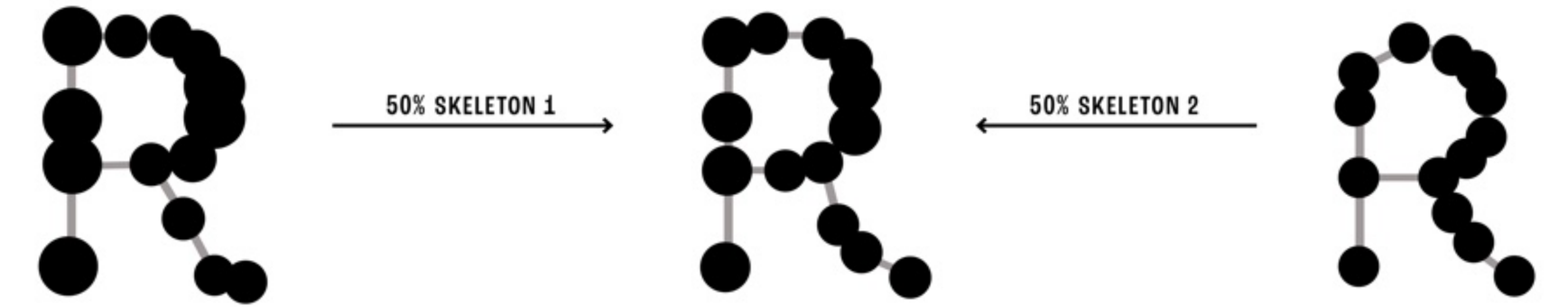
50% SKELETON 2



Reconstructed Skeleton 2

RESULTS — Transform Skeletons into Glyphs

Add the **stroke width** in each point
and **blend** them to create the new filling



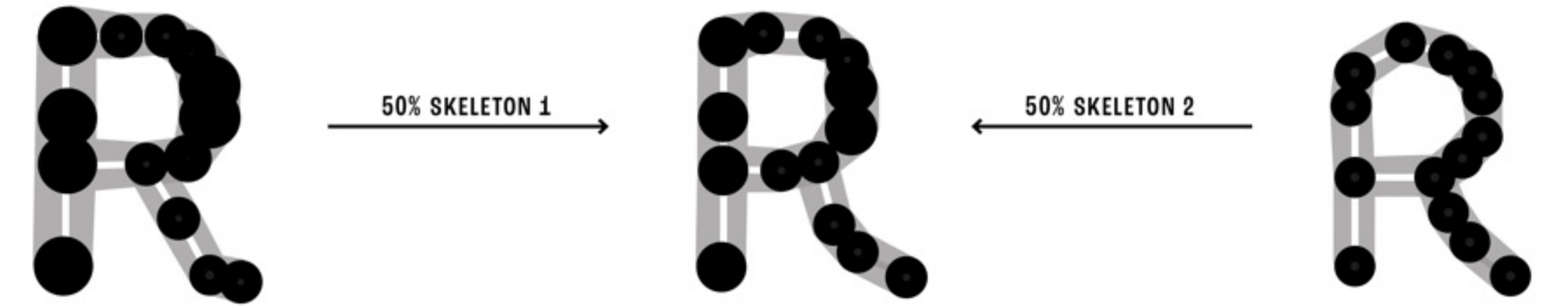
Reconstructed Skeleton 1

Generated Skeleton

Reconstructed Skeleton 2

RESULTS — Transform Skeletons into Glyphs

Connect the points with a line of varying thickness



Reconstructed Skeleton 1

Generated Skeleton

Reconstructed Skeleton 2

RESULTS — Transform Skeletons into Glyphs

Create **new glyphs**

Reconstructed Skeleton 1

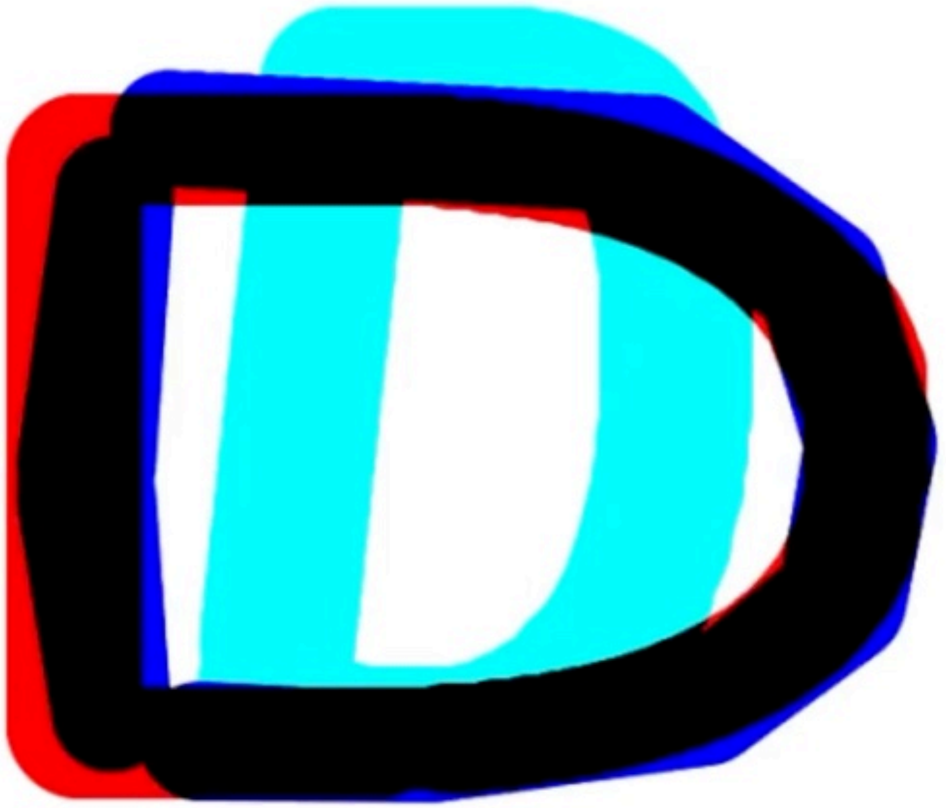
Generated Skeleton

Reconstructed Skeleton 2

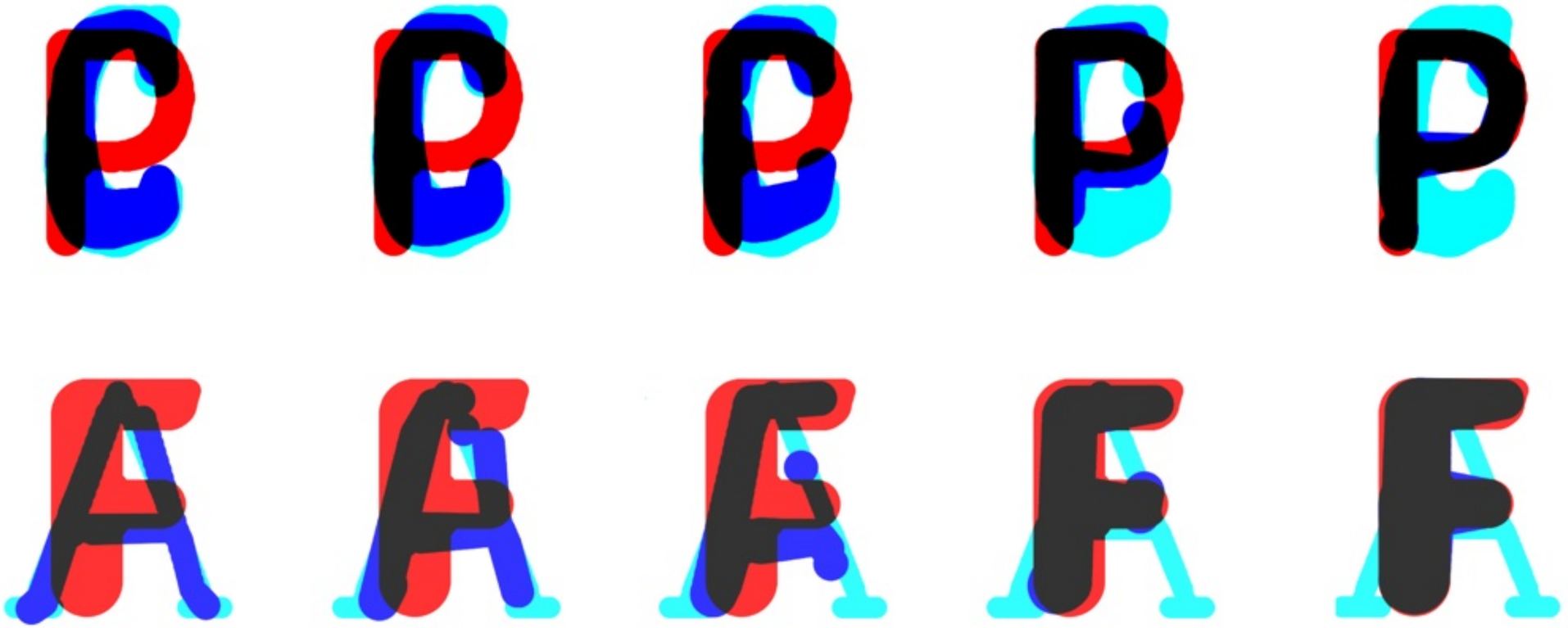
Create Design Artefacts

Create Design Artefacts

I. First Application



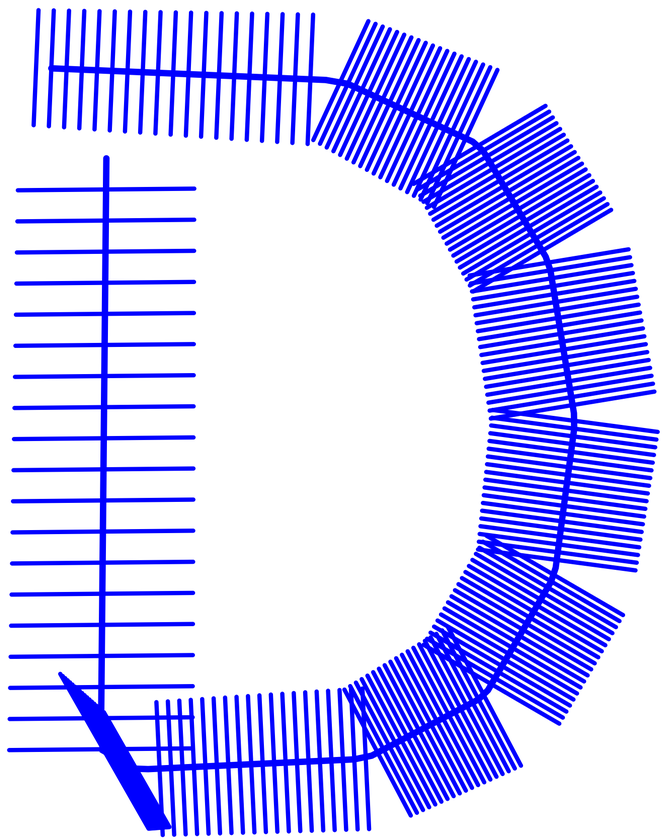
CREATE DESIGN ARTEFACTS — First Application

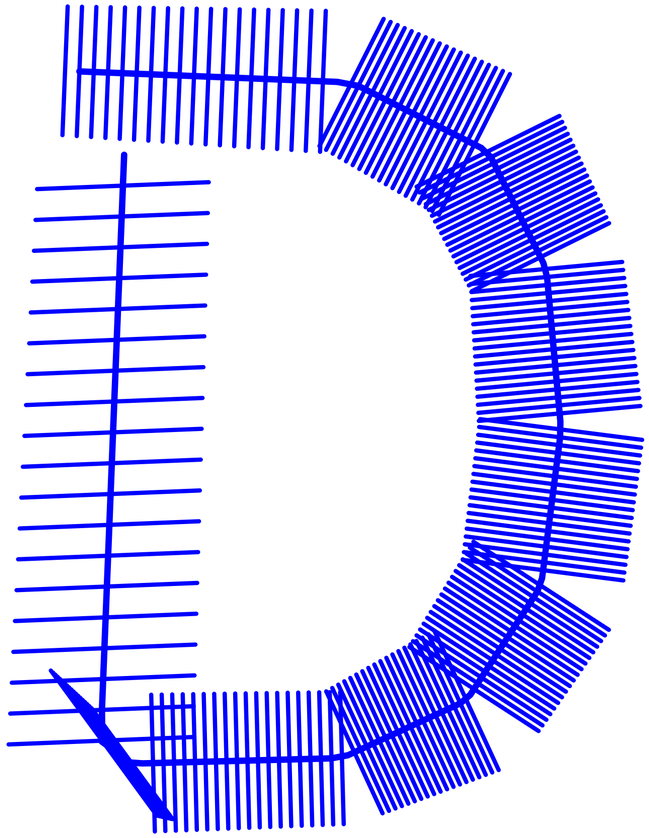


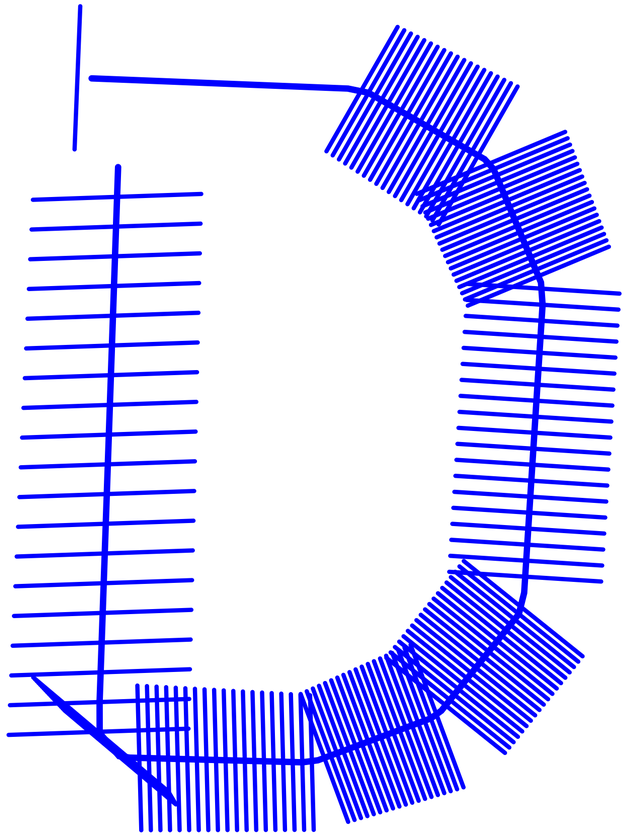

Charles Parker
GRAPHIC DESIGNER

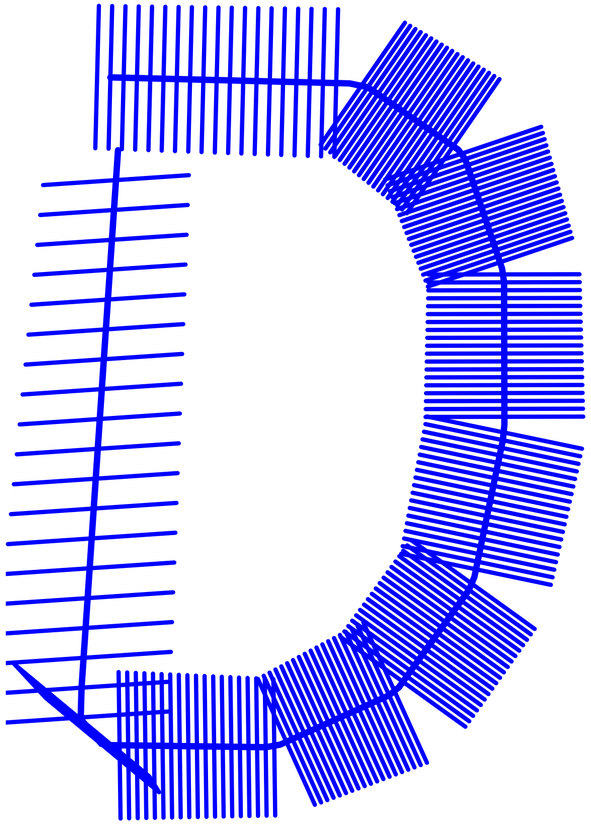
Create Design Artefacts

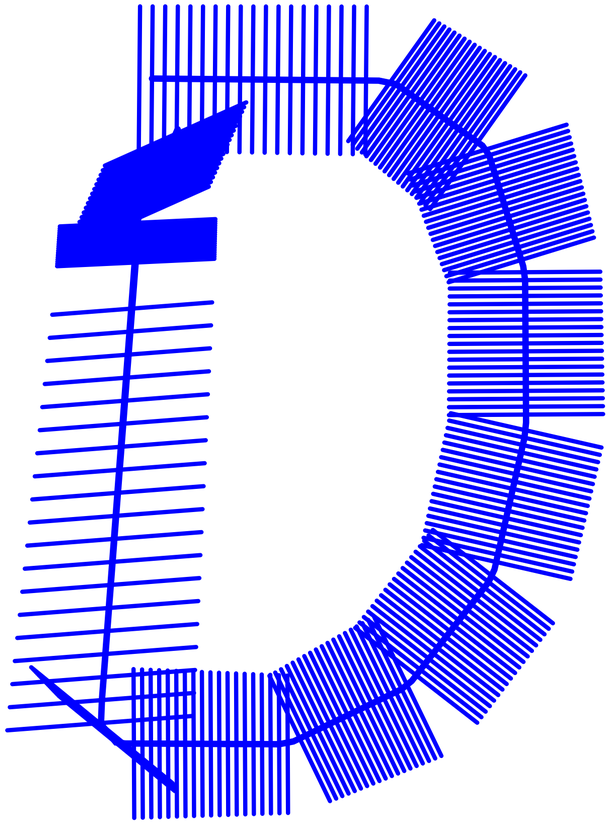
II. Second Application

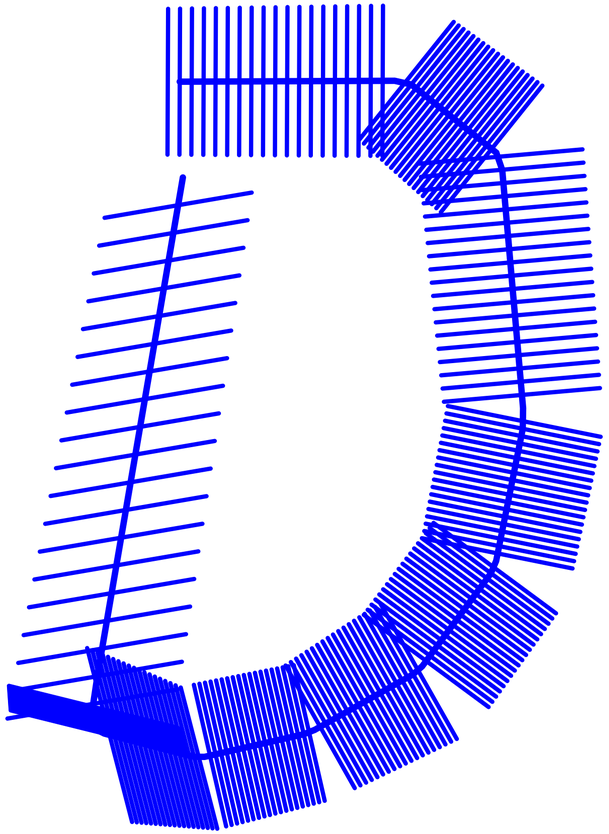


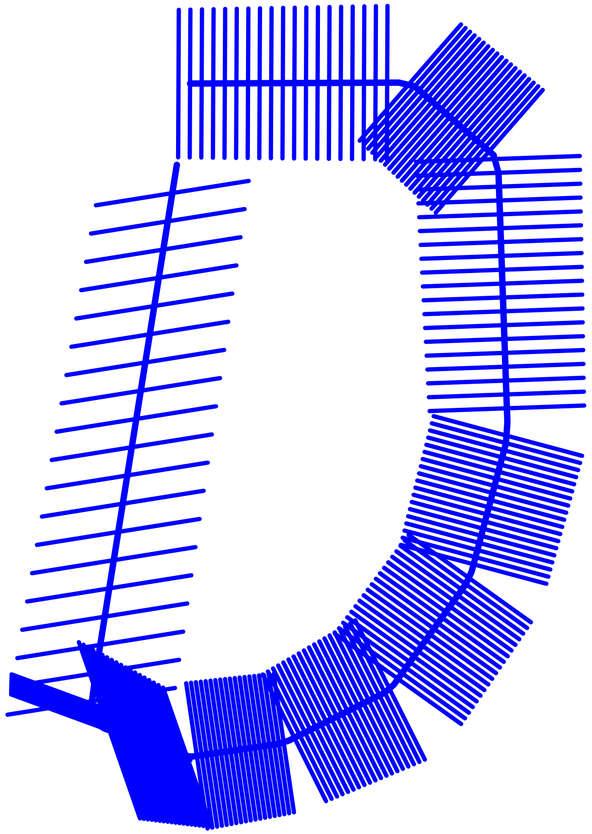


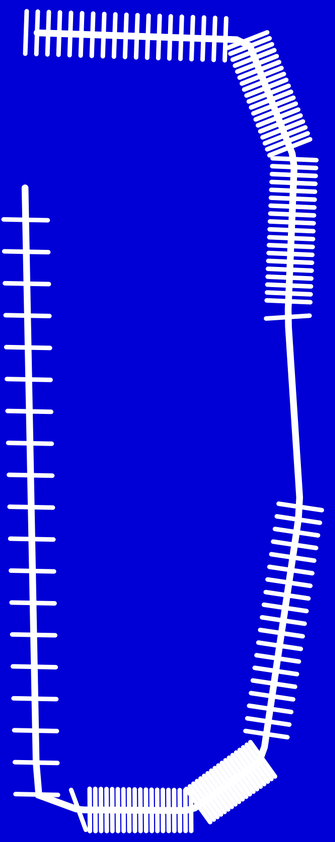


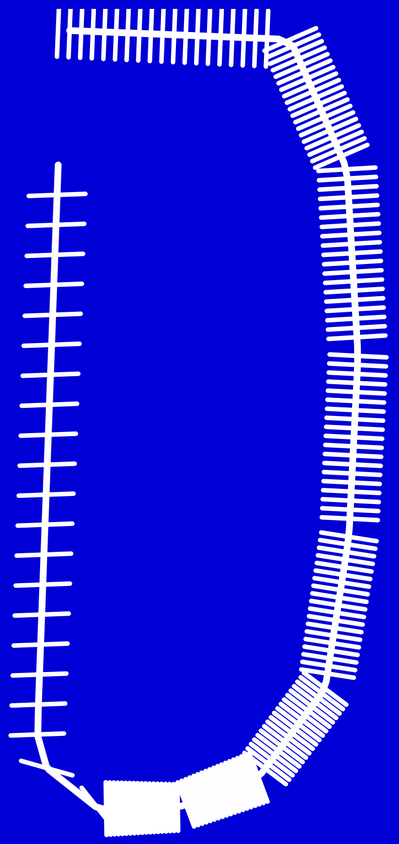




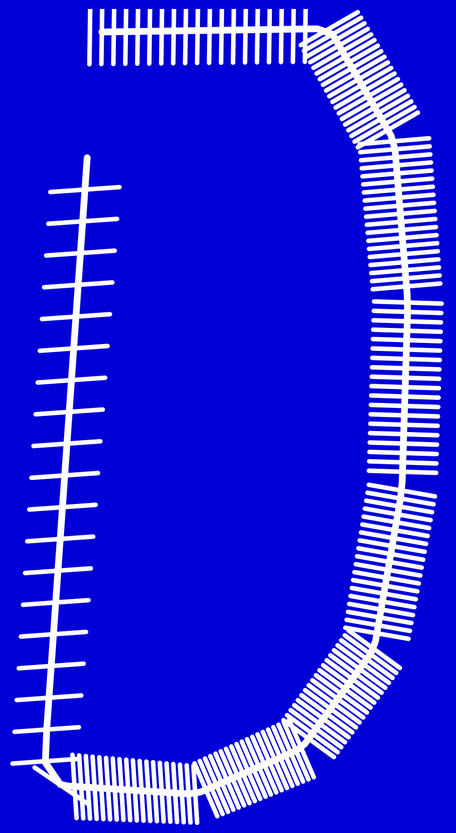


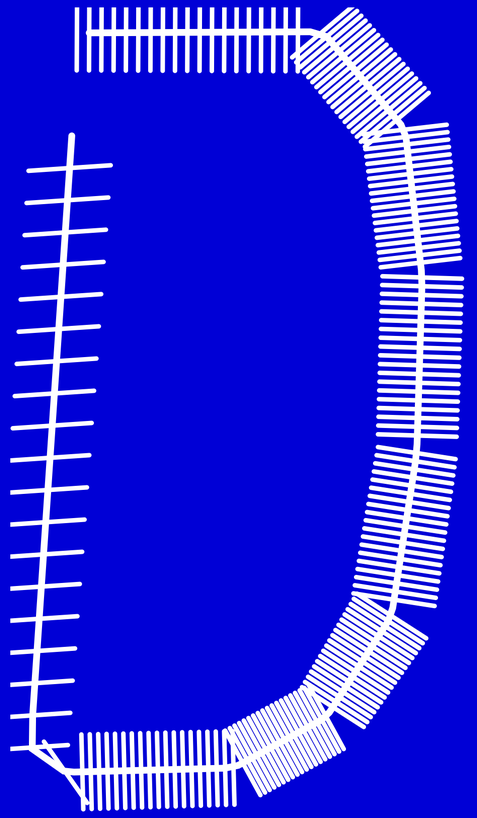


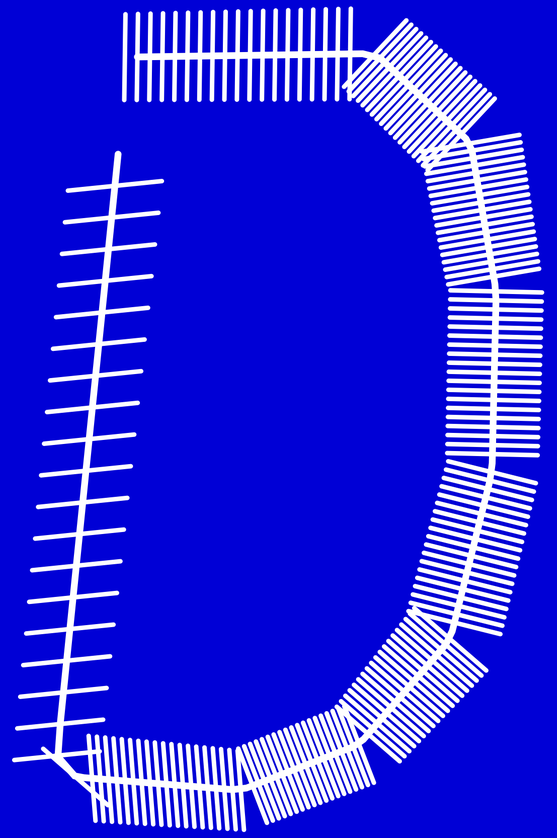


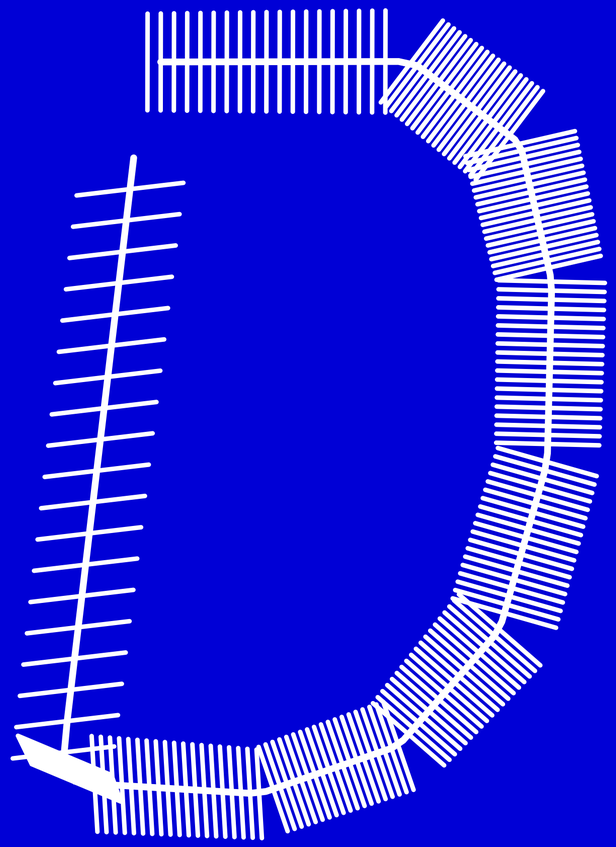


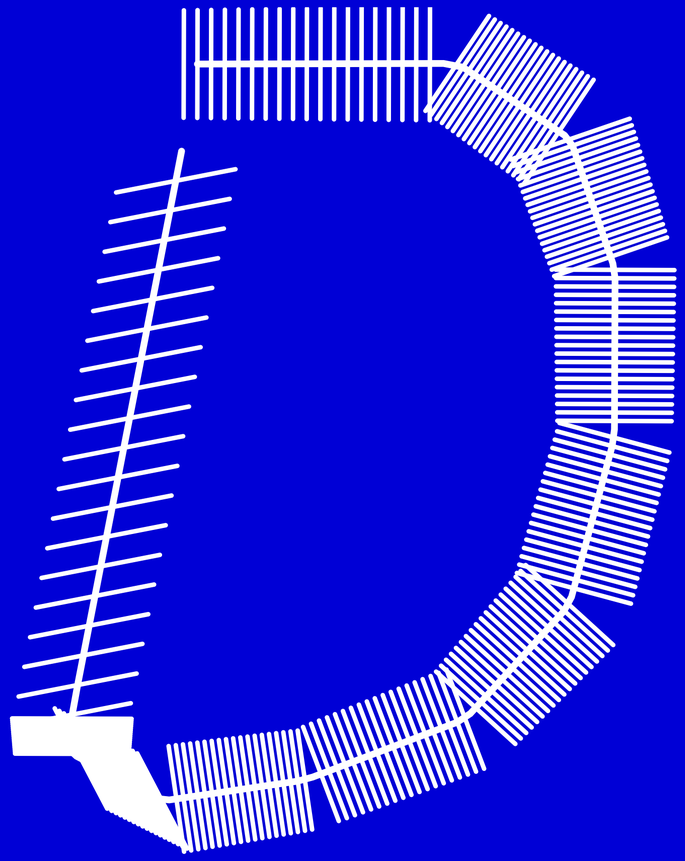
CREATE DESIGN ARTEFACTS — Second Application

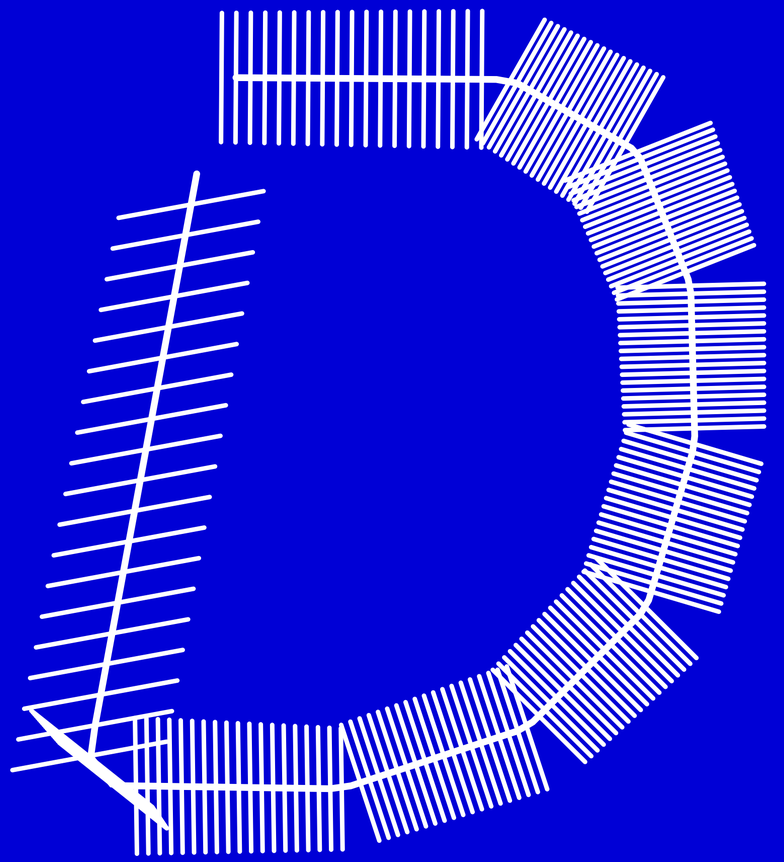










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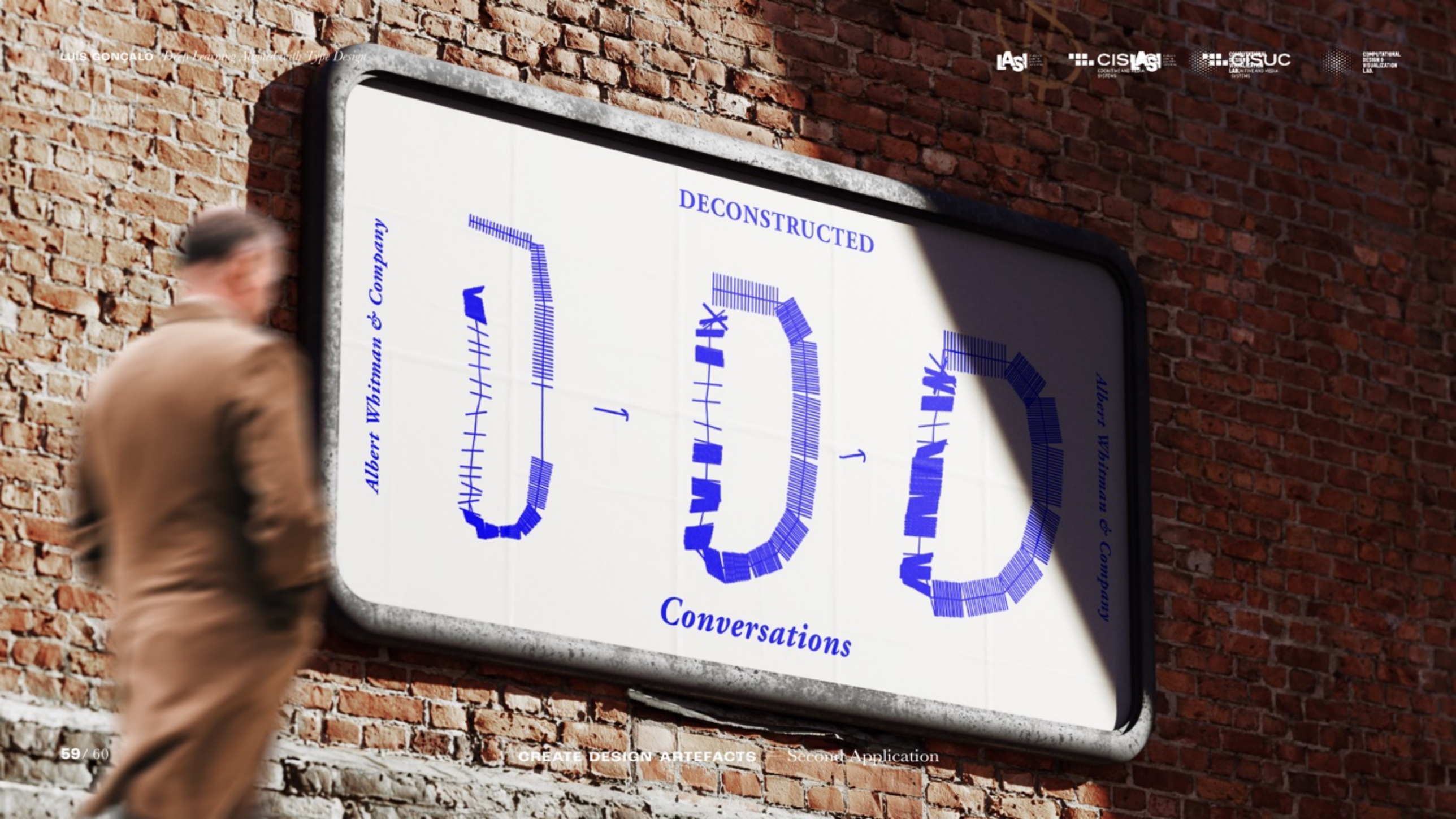
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Conversations

Thank You!

LUÍS GONÇALO
lgoncalo@dei.uc.pt

JÉSSICA PARENTE
jparente@dei.uc.pt