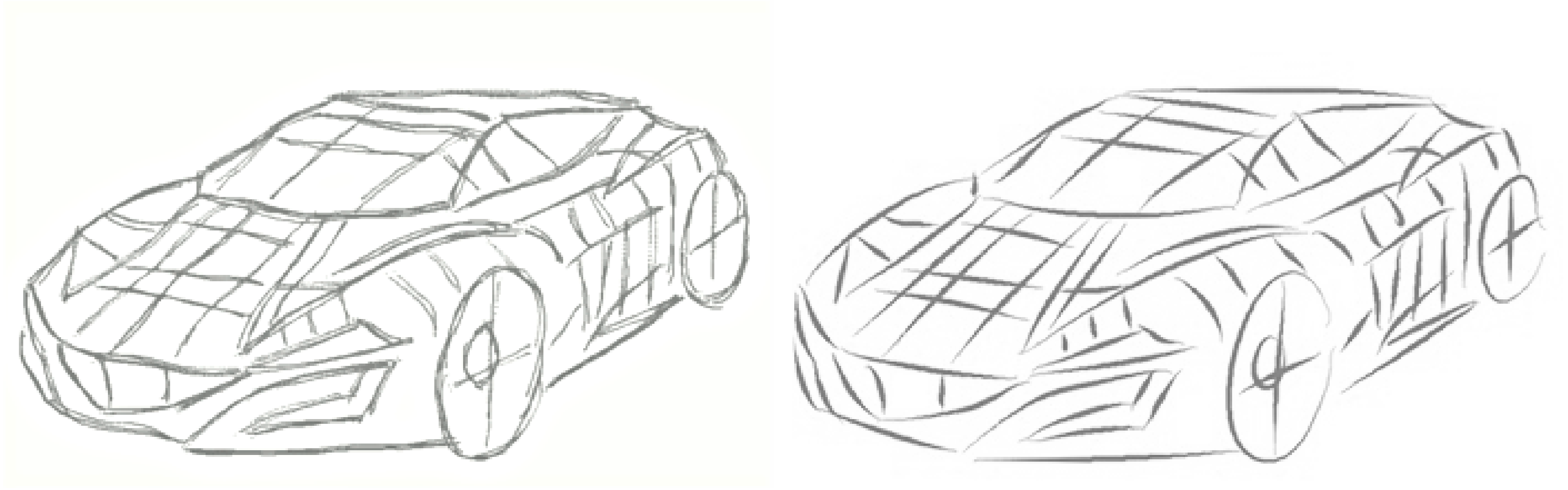
Improving of vector sketches



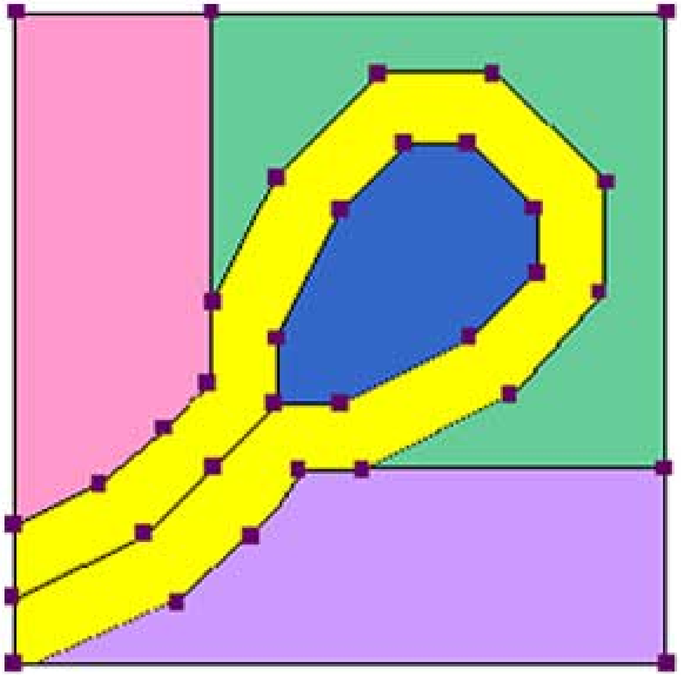
Igor Kostiuk

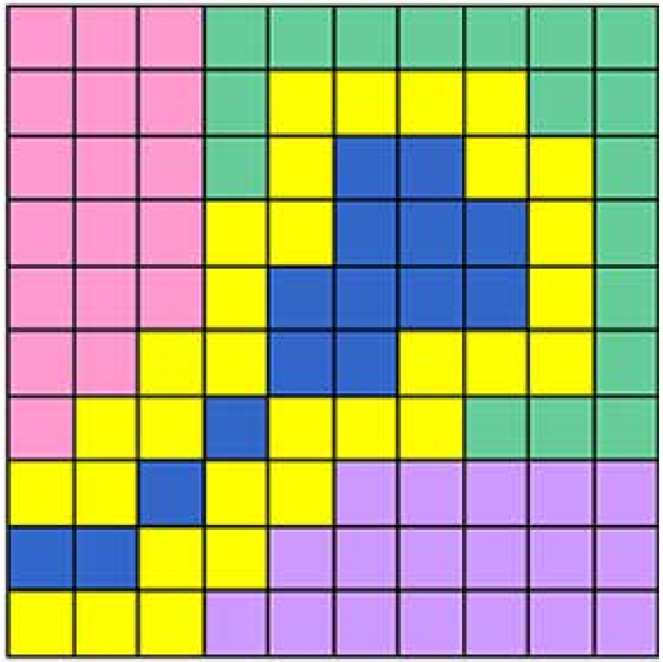
2016

v. 1.1

Ancient times

Nowadays



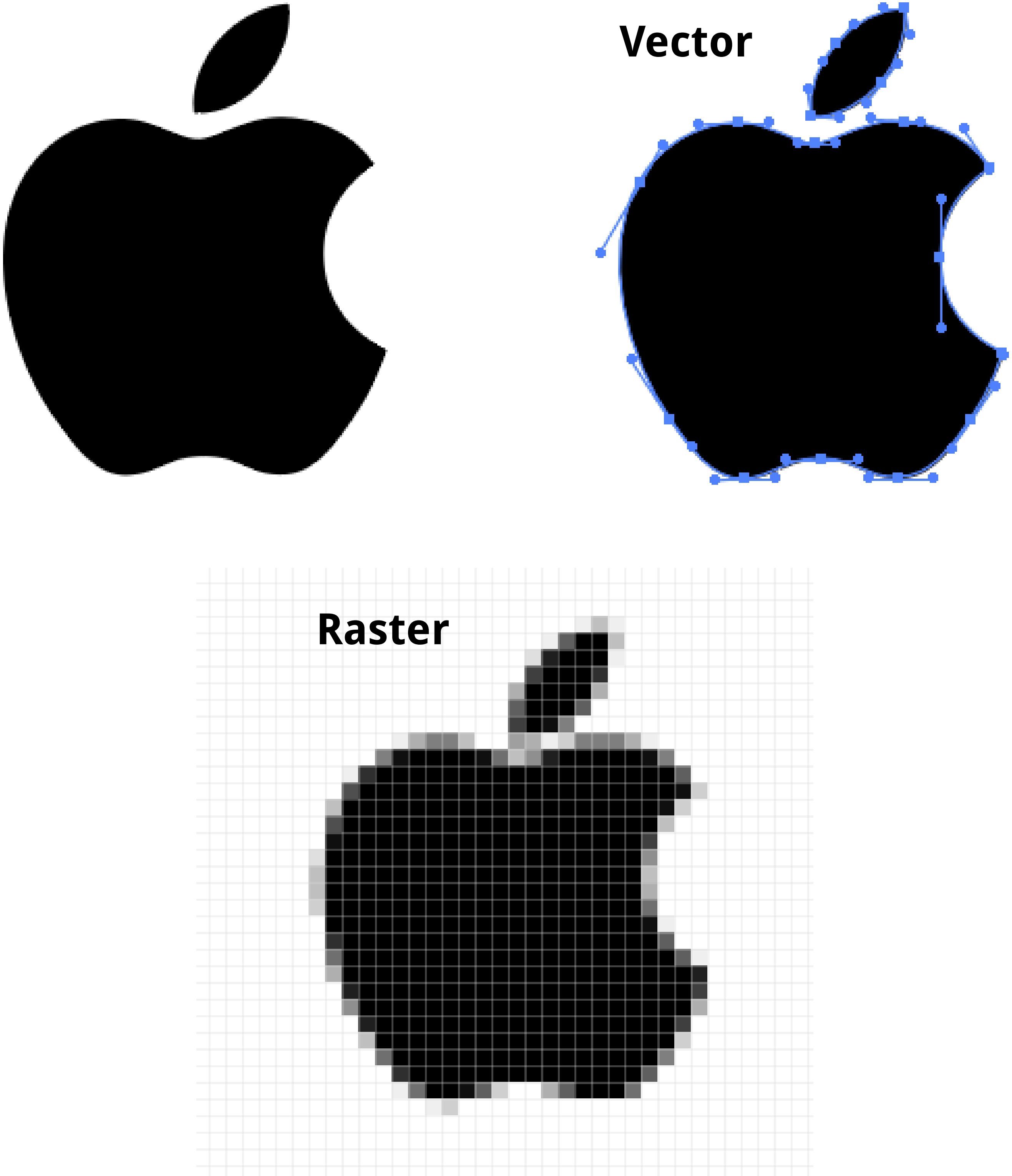


Vector

- Shapes;
- Can be scaled to any size without losing quality;
- Best for creating logos, drawings and illustrations;

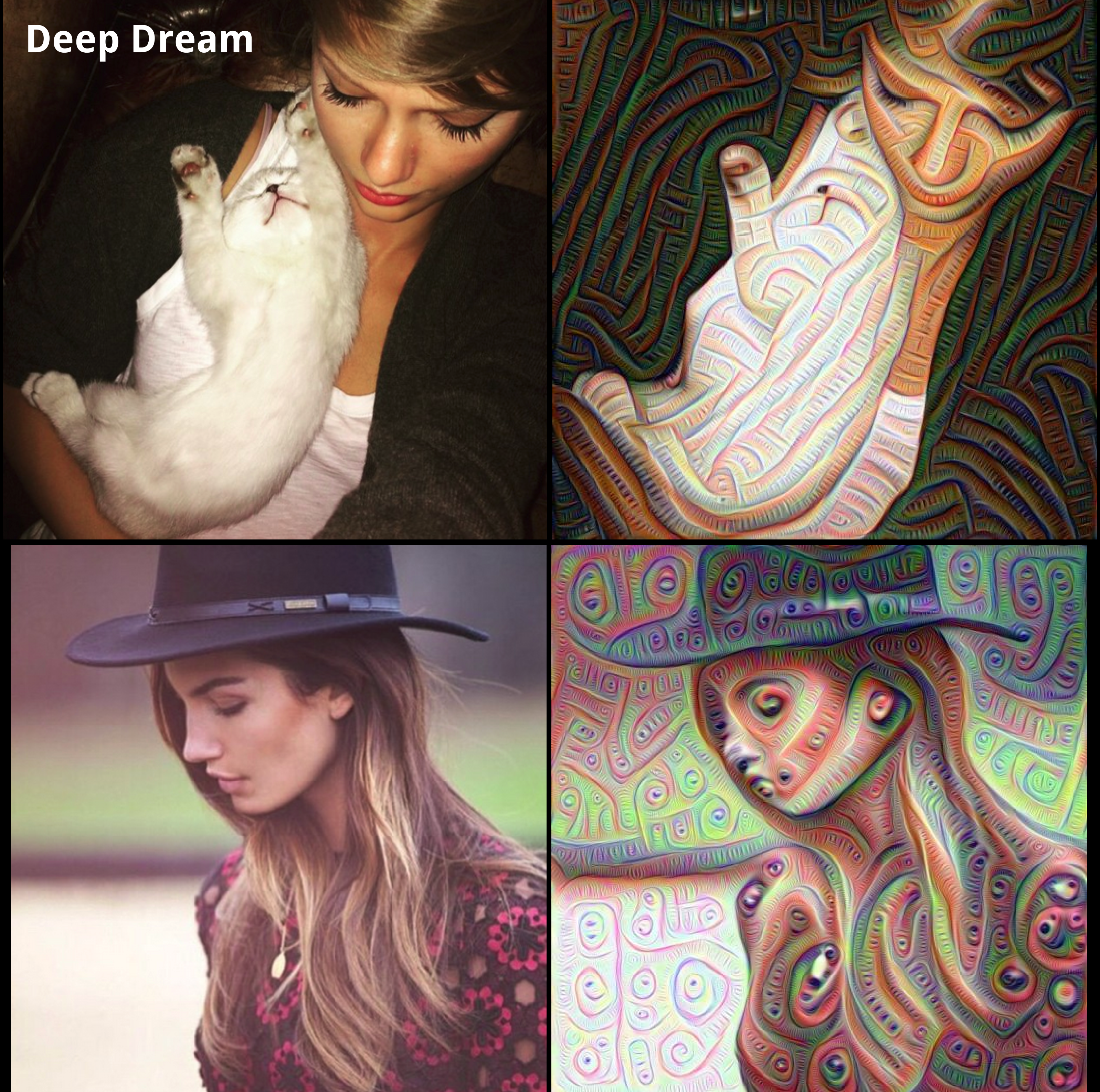
Raster

- Pixels;
- Do not scale up optimally;
- Best for editing photos;

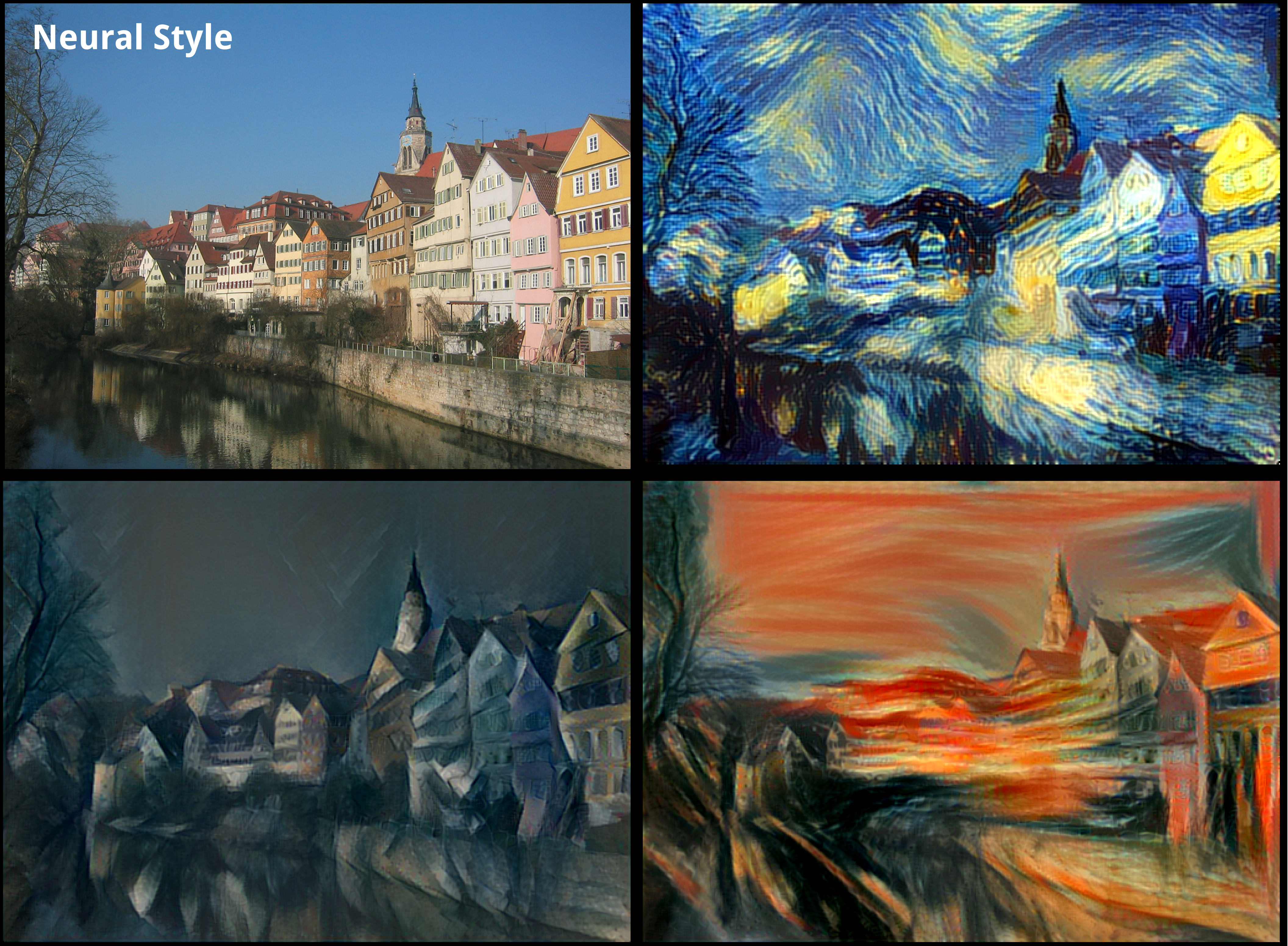

Vector
Raster

Using AI in visual arts

Deep Dream



Neural Style



Can be used as filters for already drawn pictures / photos or for mixing of two styles in one.

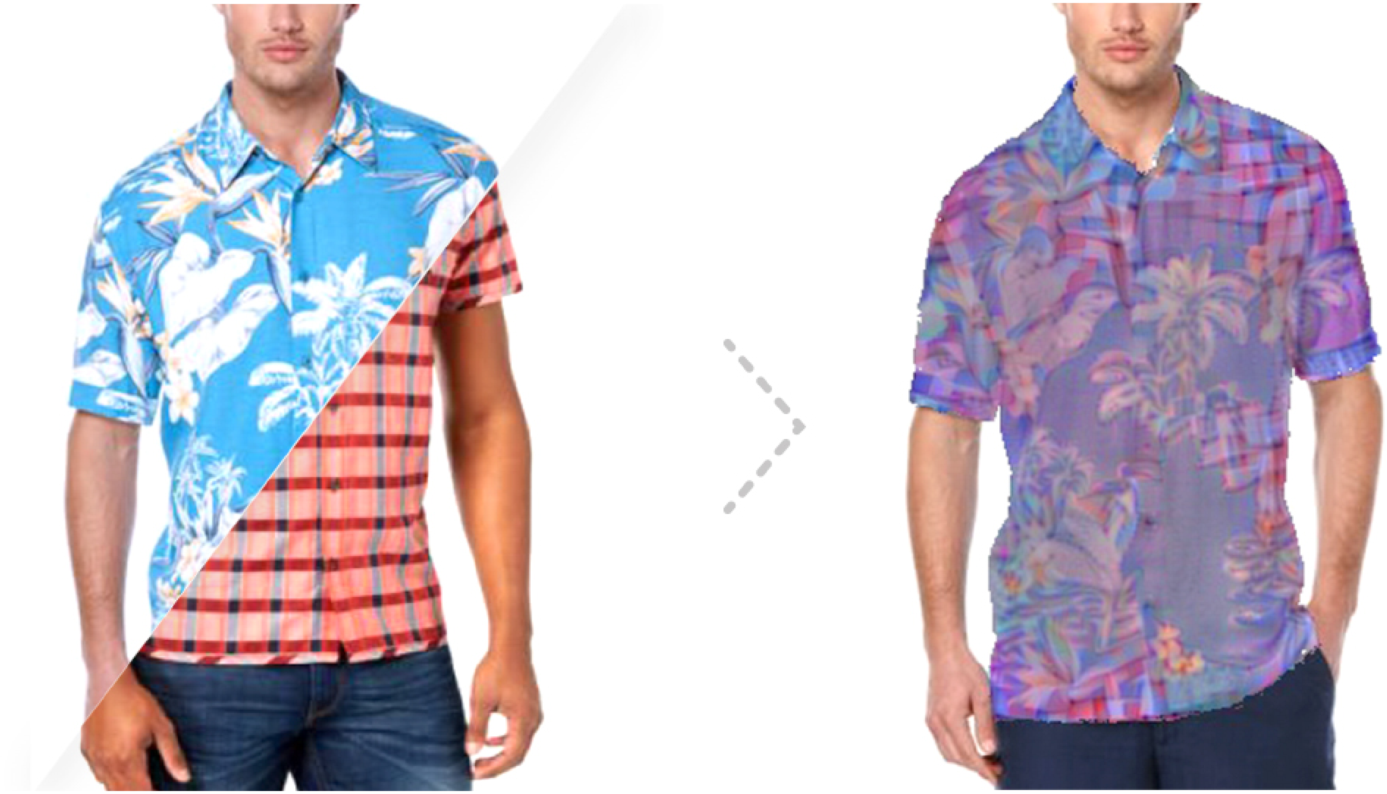
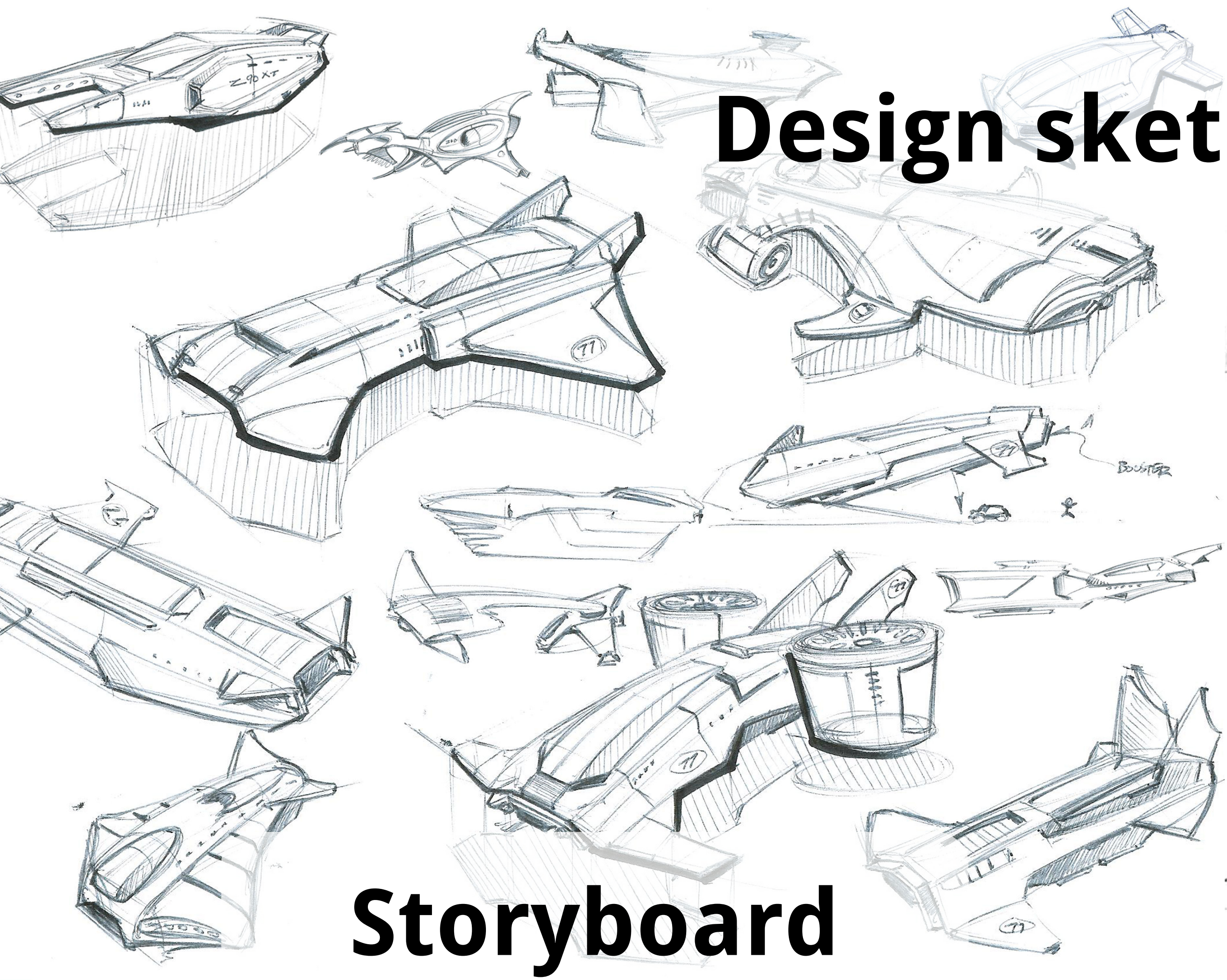
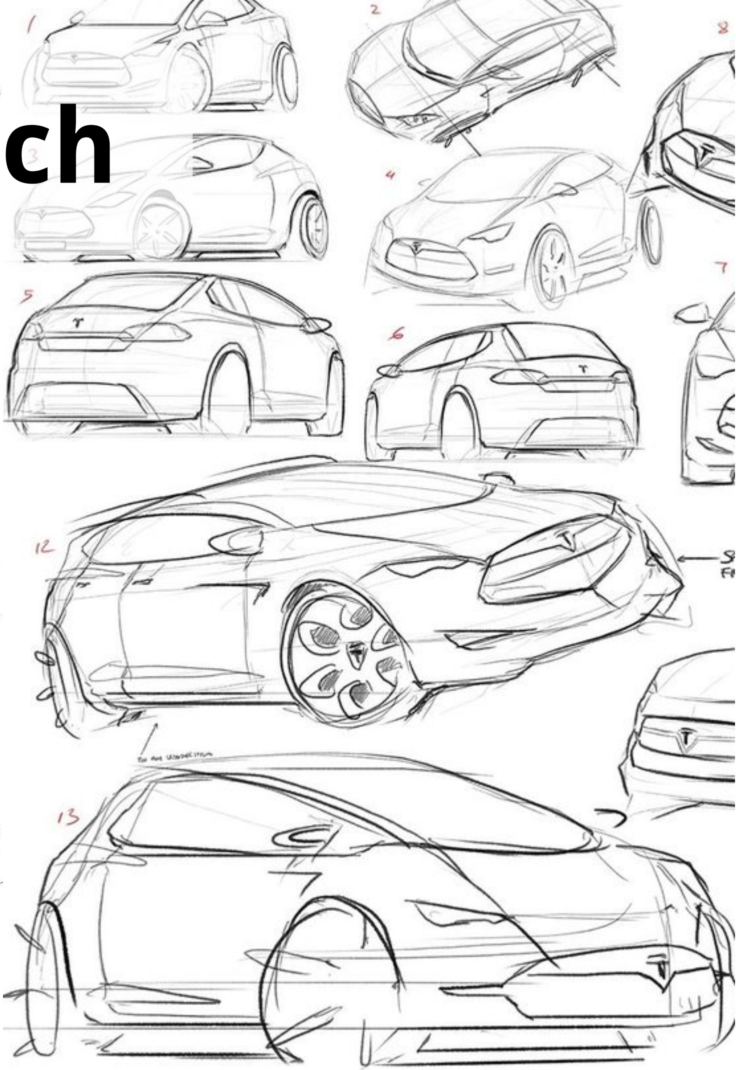


image credit: elekslabs

Sketching

Design sketch





Storyboard

Scene C144 Panel 1/6
Scene C144 Panel 2/6
Scene C144 Panel 3/6
Scene C144 Panel 4/6
Scene C144 Panel 5/6
Scene C144 Panel 6/6
Scene C145 Panel 1/6
Scene C145 Panel 2/6
Scene C145 Panel 3/6
Scene C145 Panel 5/6
Scene C145 Panel 6/6

Raster

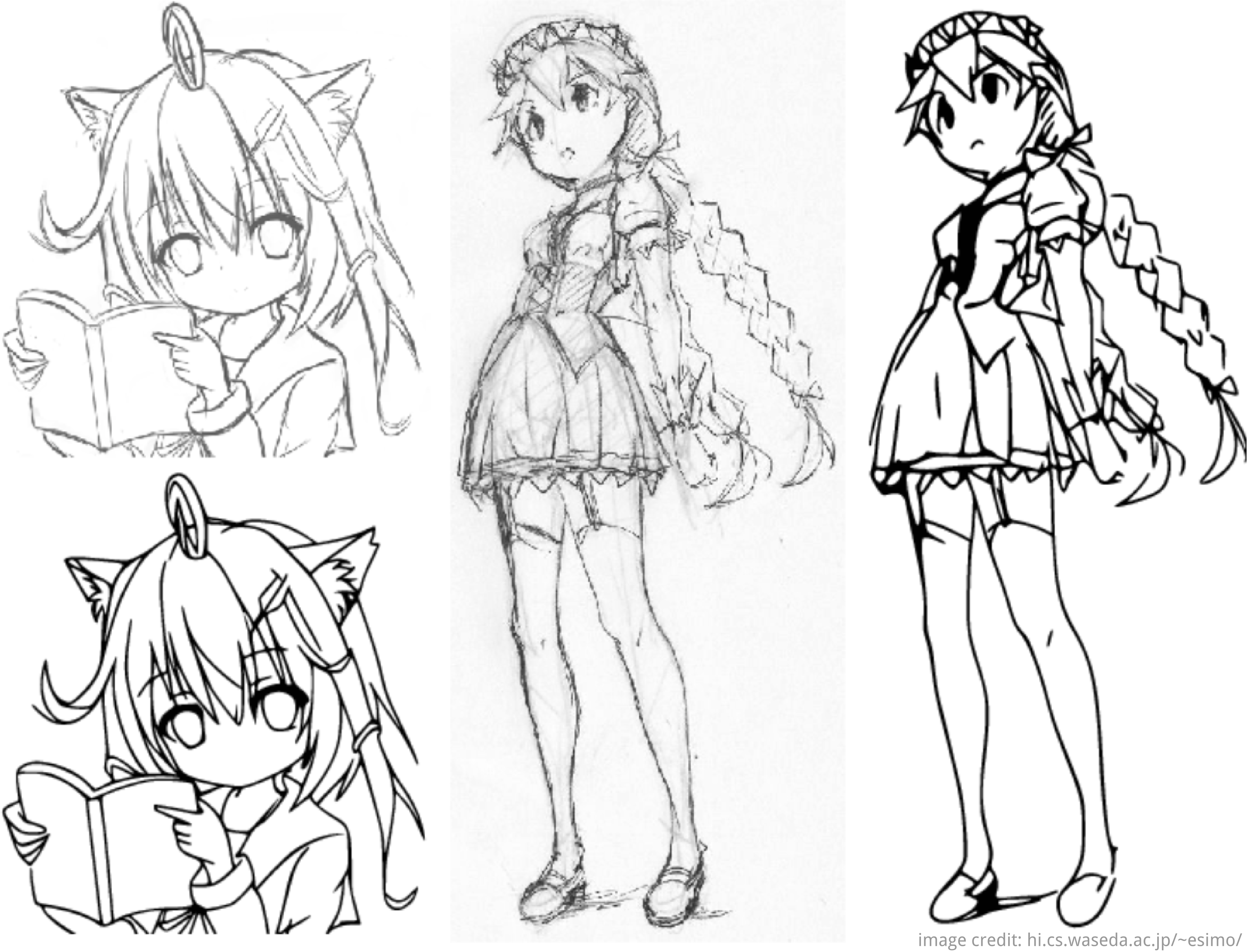


image credit: hi.cs.waseda.ac.jp/~esimo/

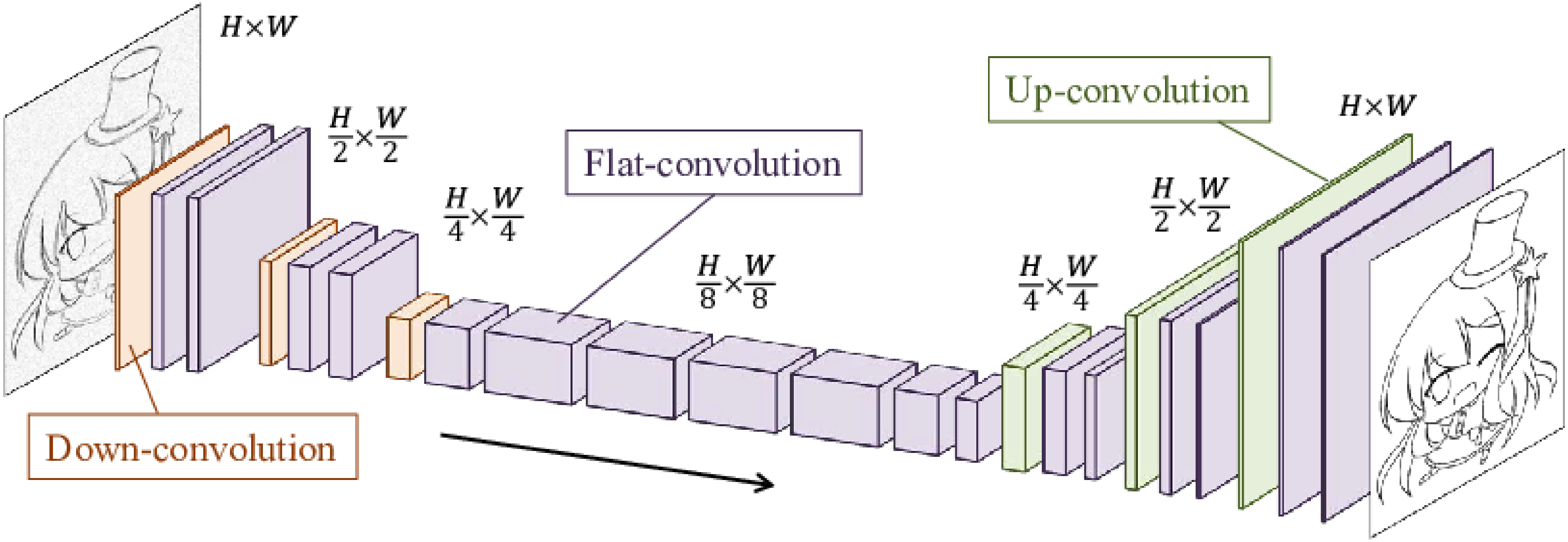
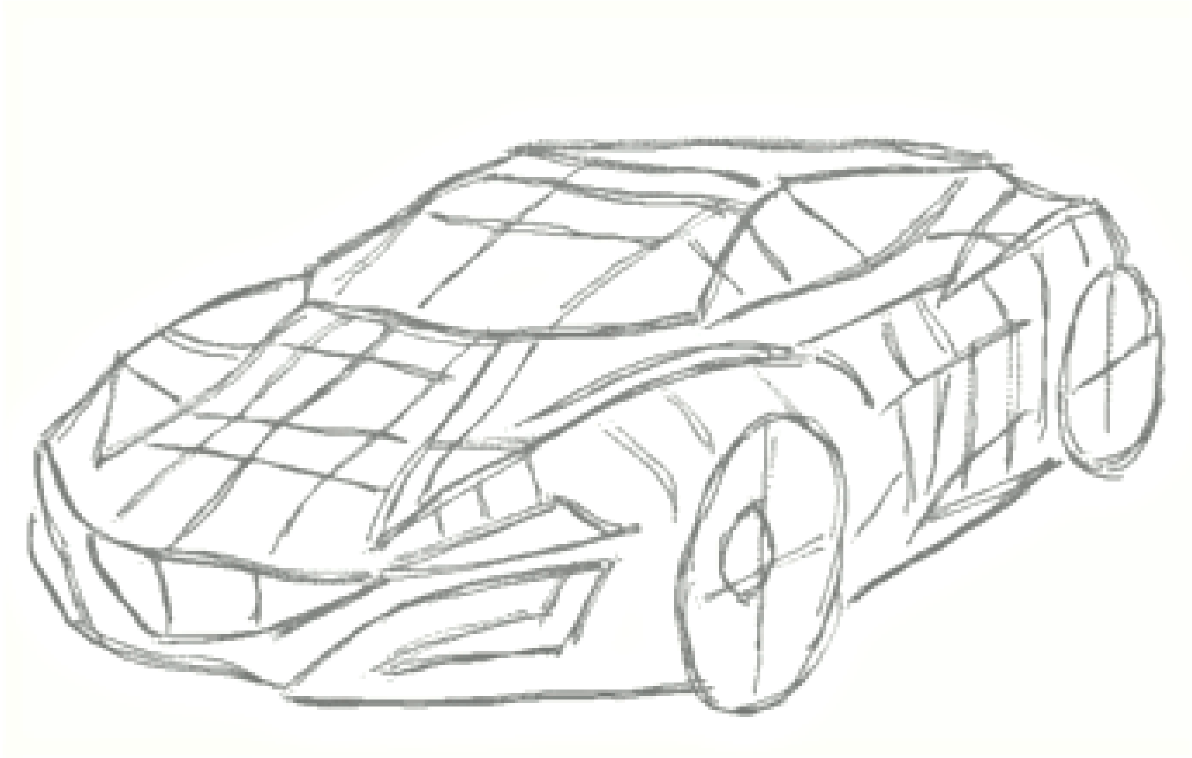

$H \times W$
$\frac{H}{2} \times \frac{W}{2}$
$\frac{H}{4} \times \frac{W}{4}$
Flat-convolution
$\frac{H}{8} \times \frac{W}{8}$
$\frac{H}{4} \times \frac{W}{4}$
$\frac{H}{2} \times \frac{W}{2}$
Up-convolution
$H \times W$
Down-convolution

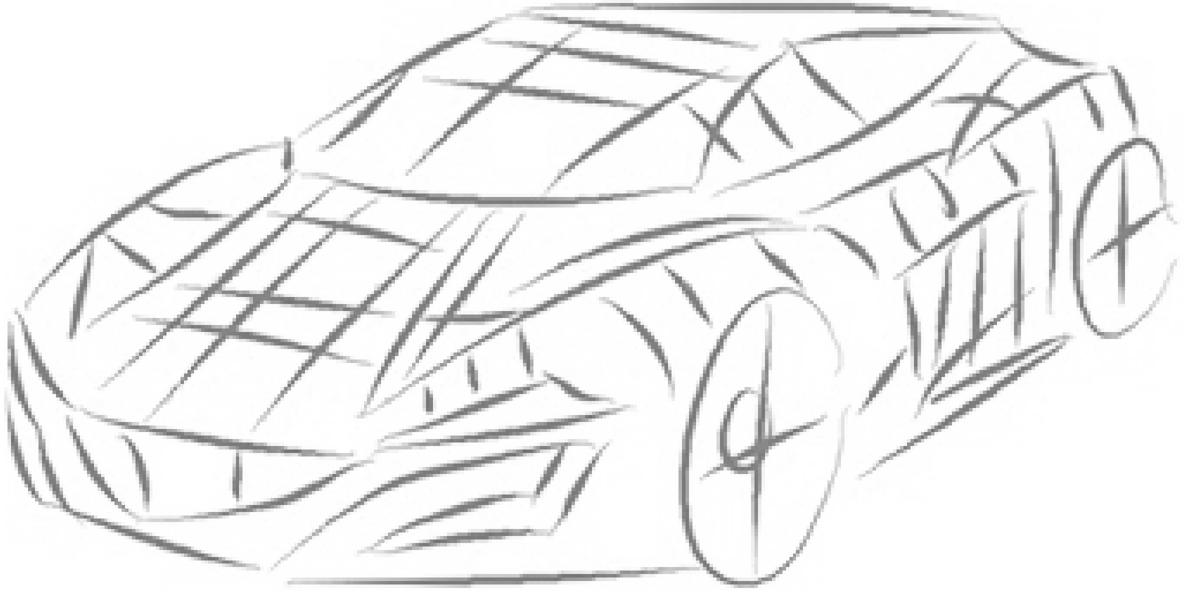
image credit: hi.cs.waseda.ac.jp/~esimo/

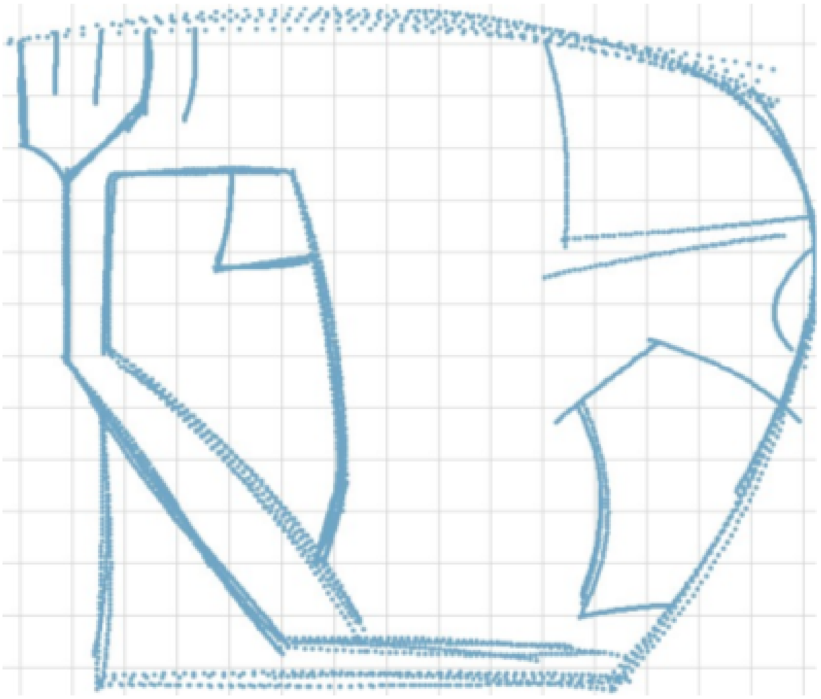
Vector



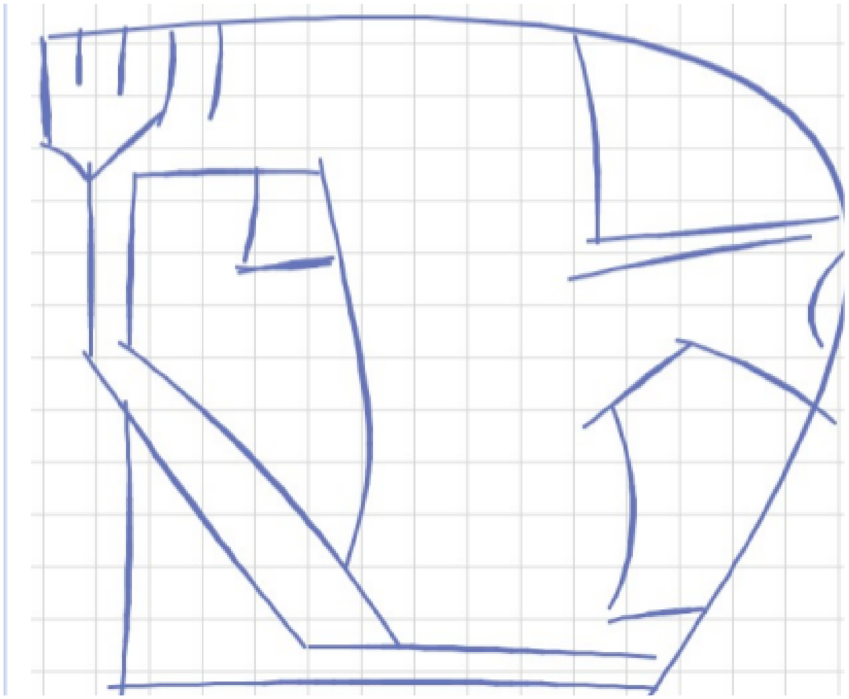
Before

After





Before

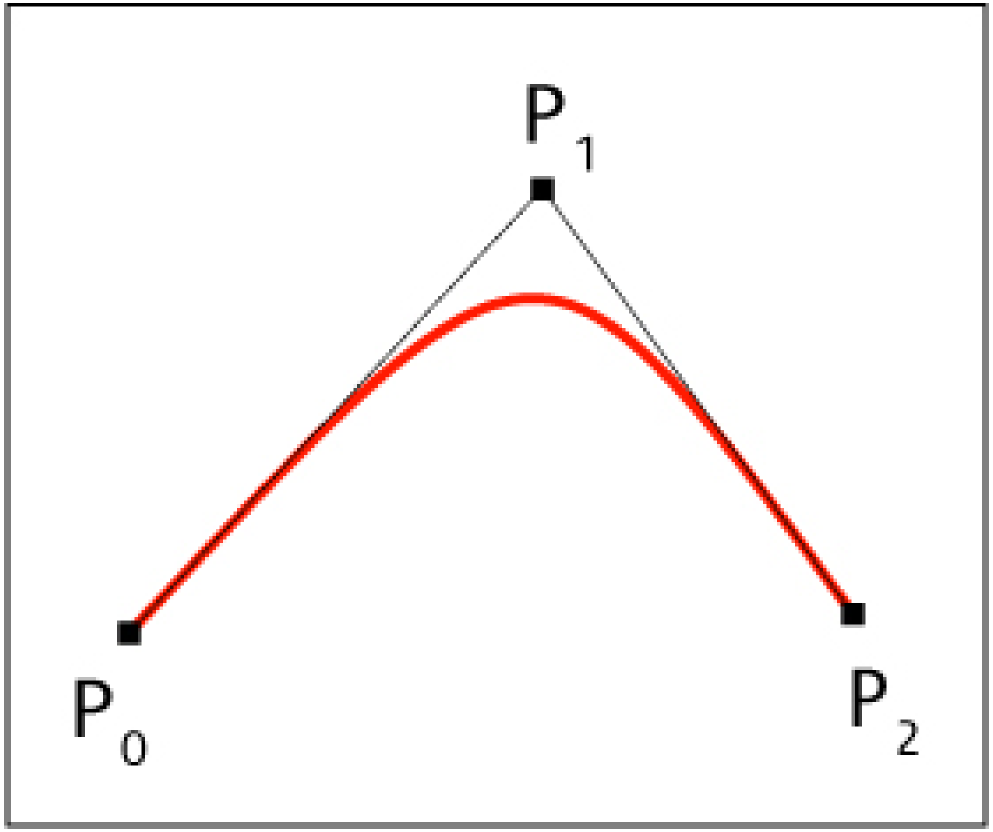


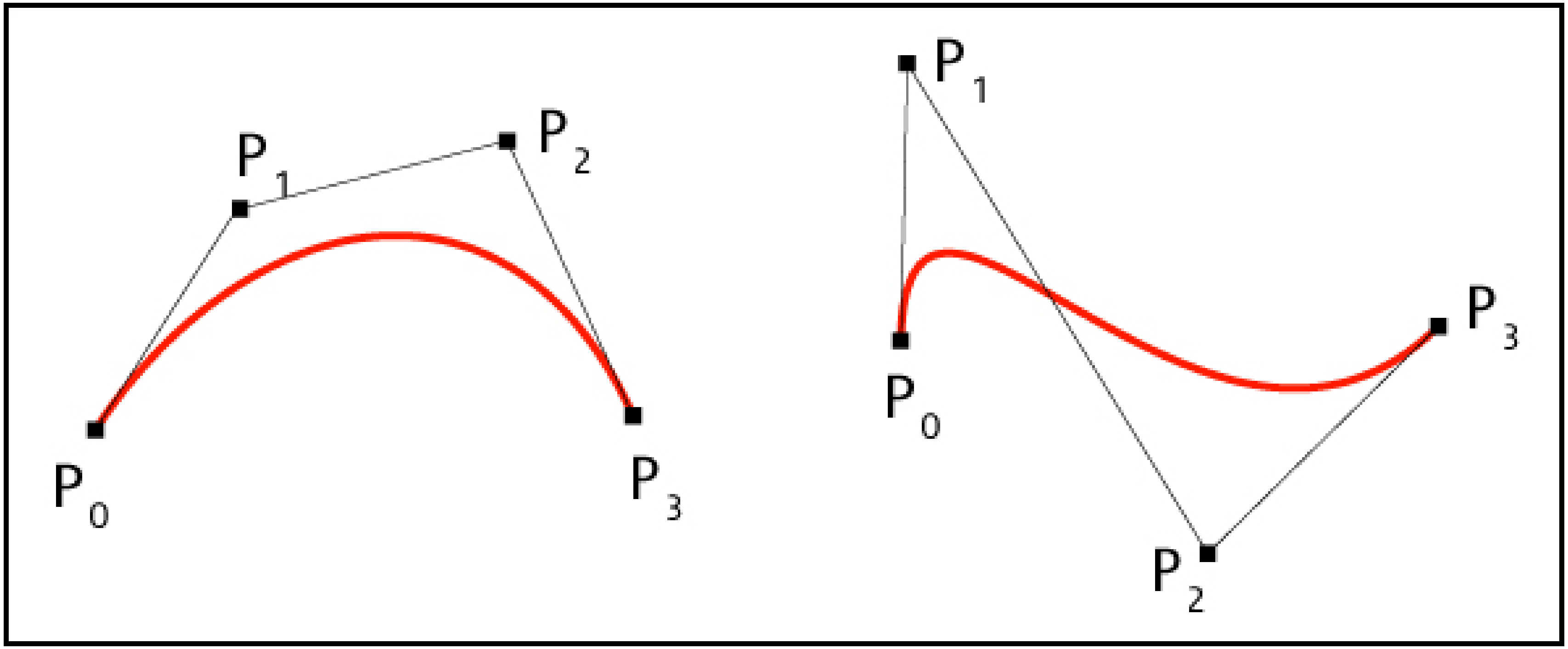
After

We have no pixel grid in vector graphics.

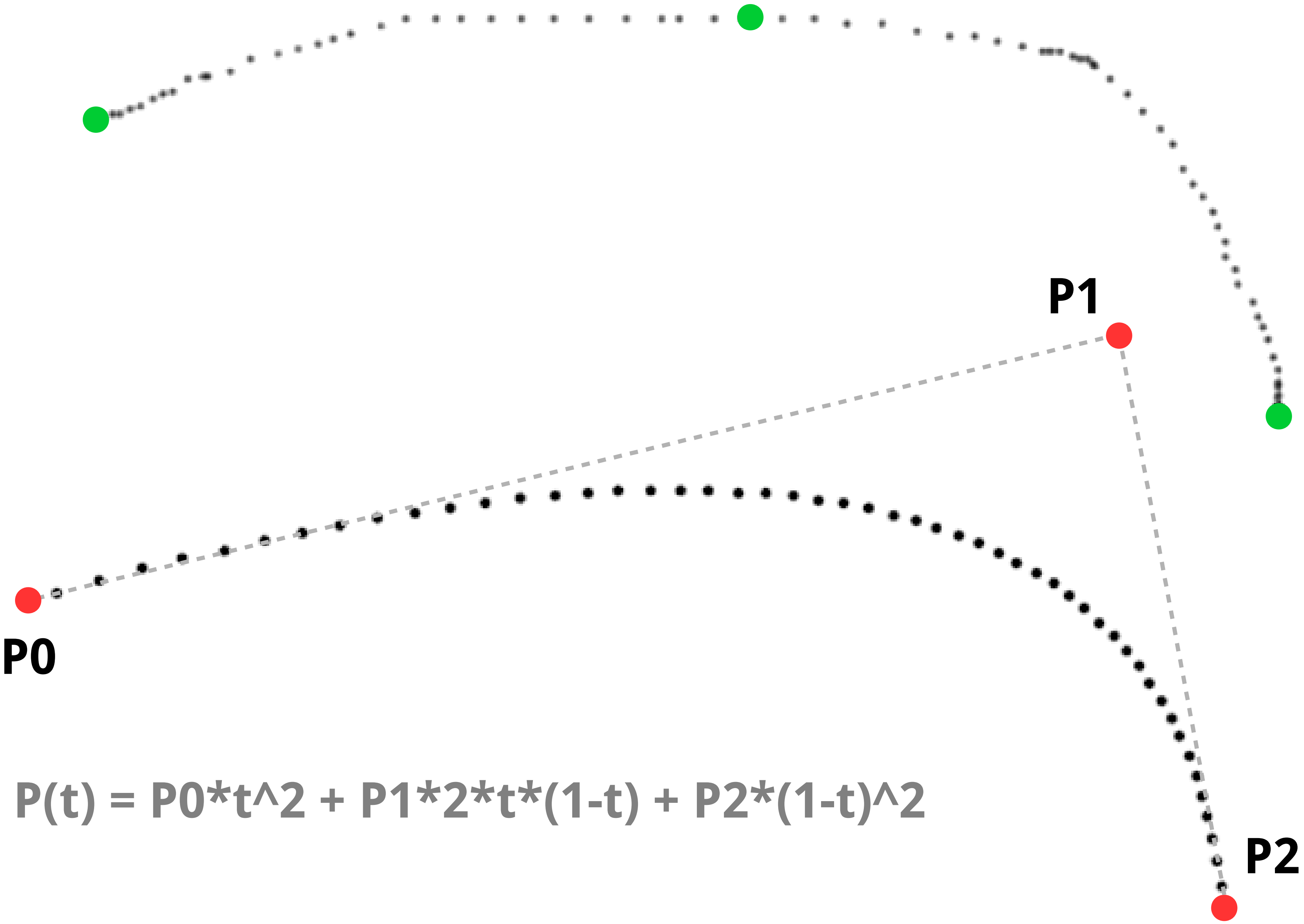
We have only points described as coordinates (x,y) and curves formed by mathematical calculations.

Bezier curve



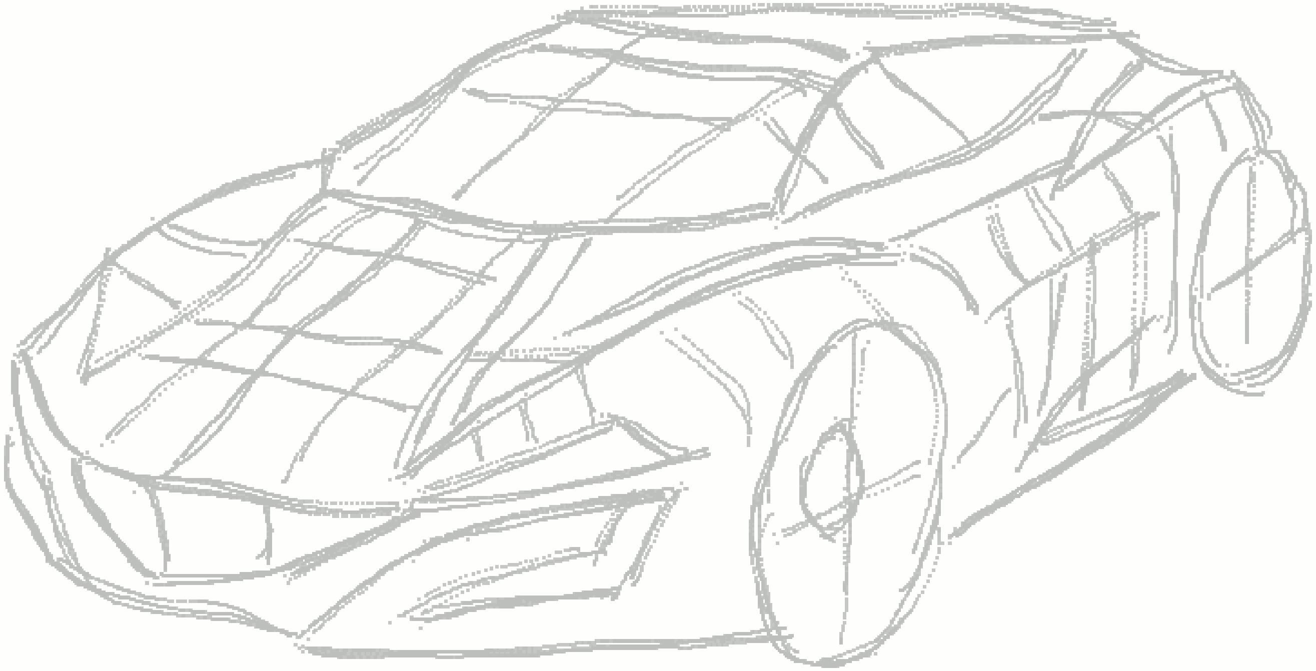


Data collection and preprocessing

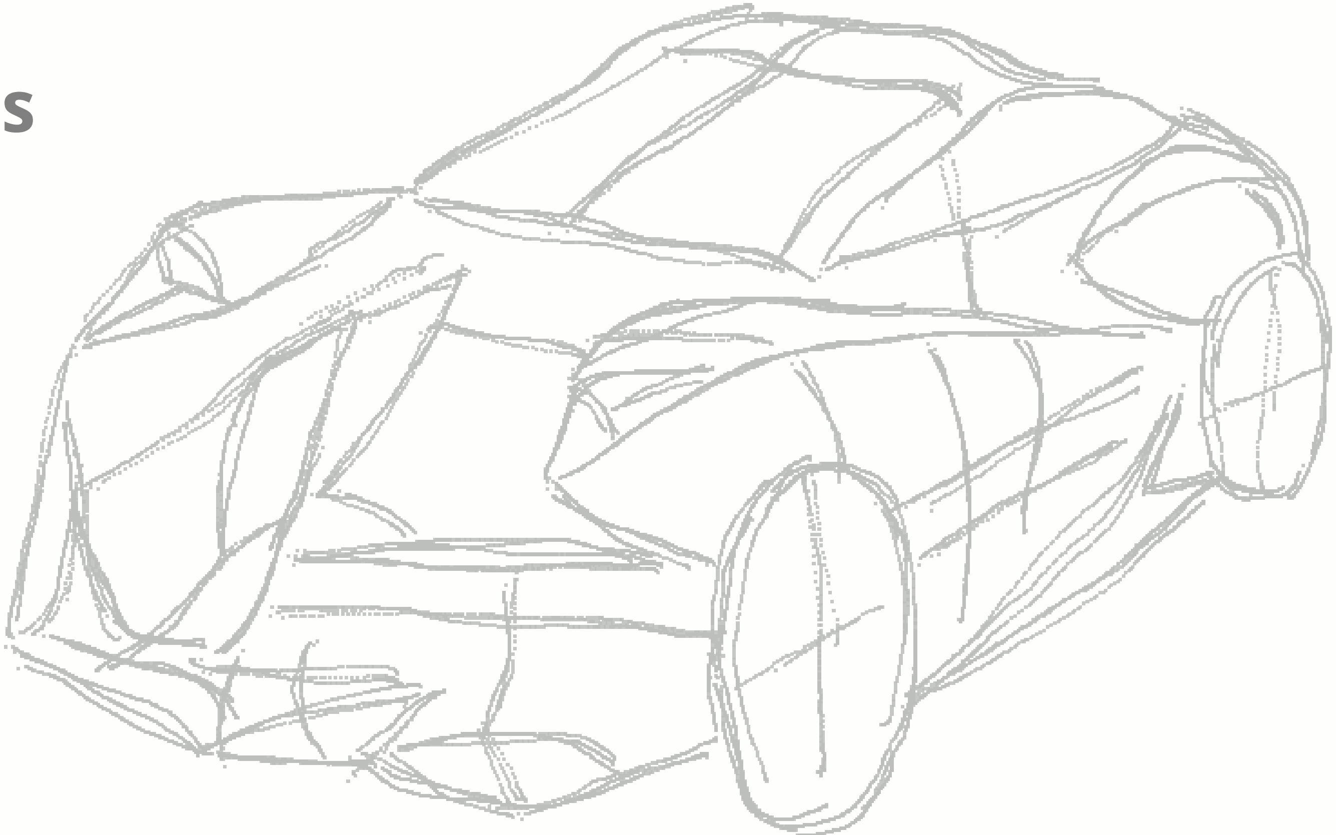


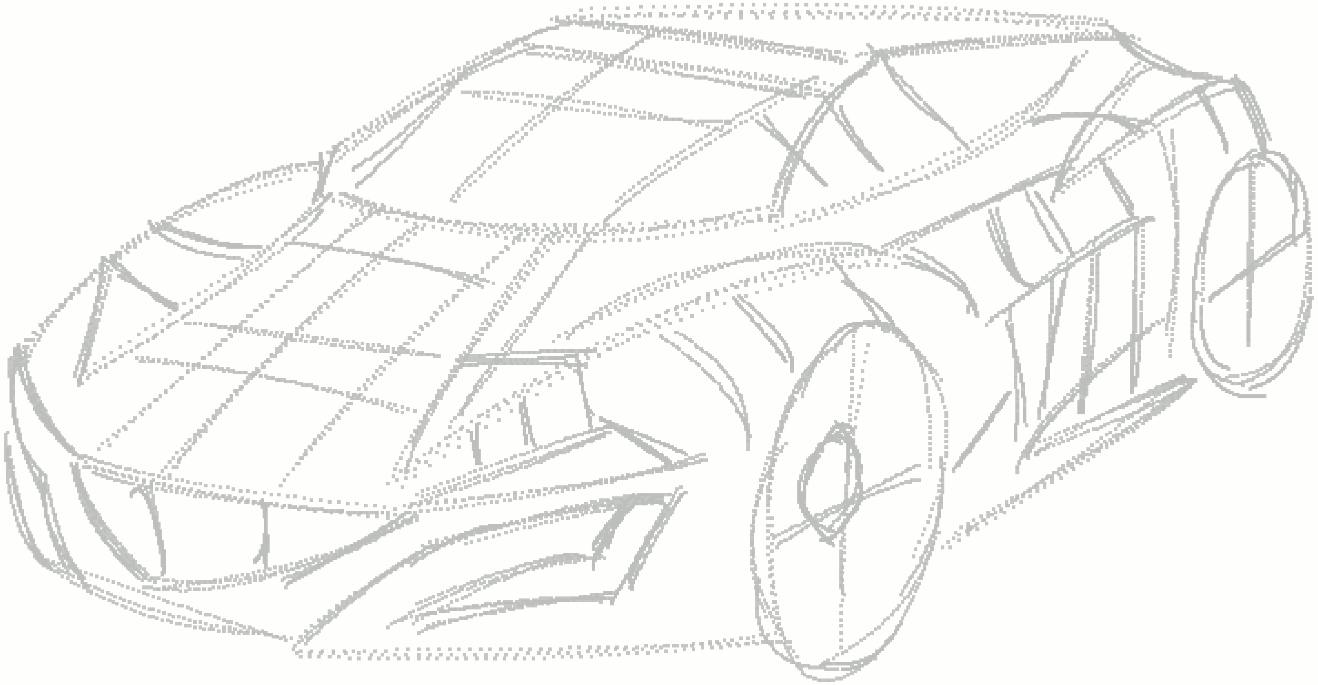
P(t) = P0*t^2 + P1*2*t*(1-t) + P2*(1-t)^2

https://youtu.be/4XSfTJfo1bE

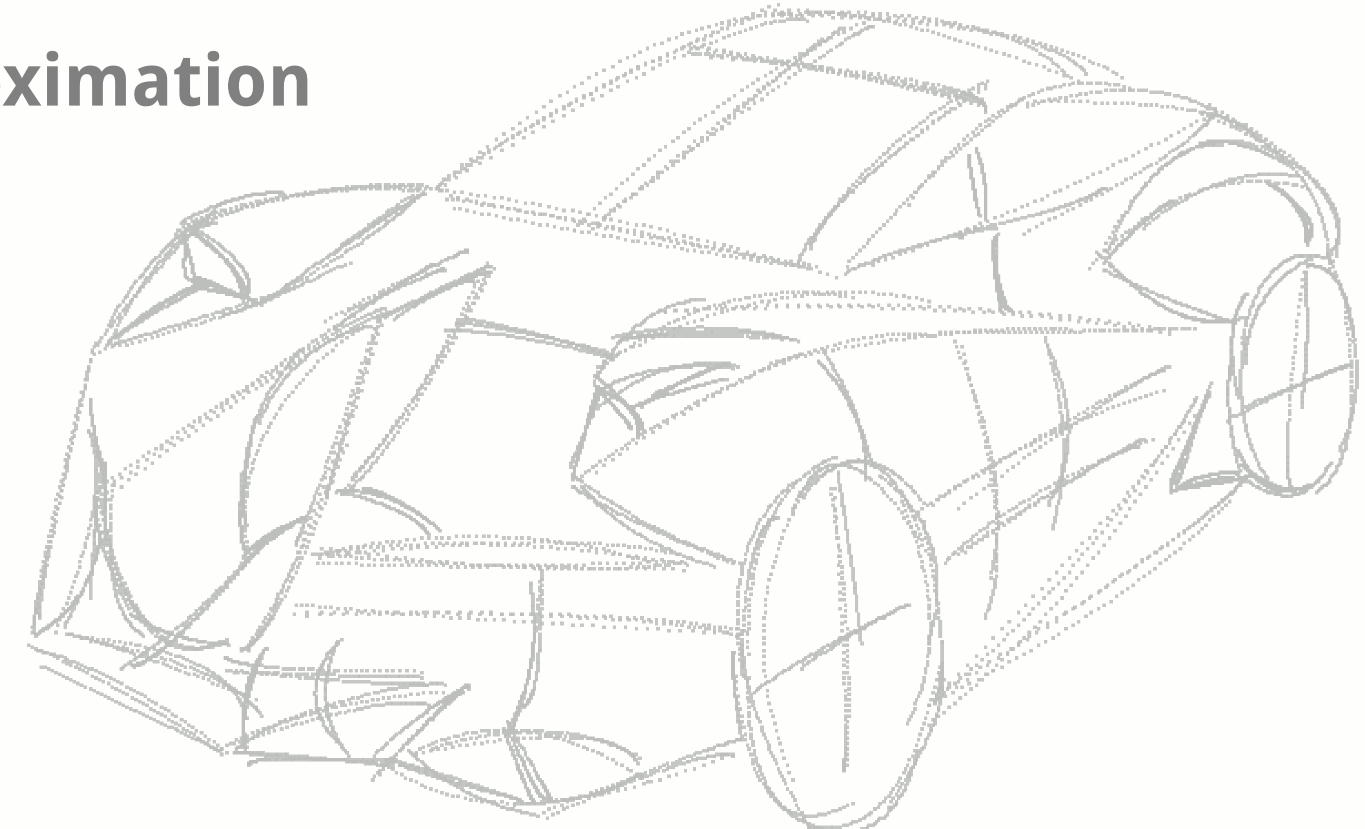


Original sketches

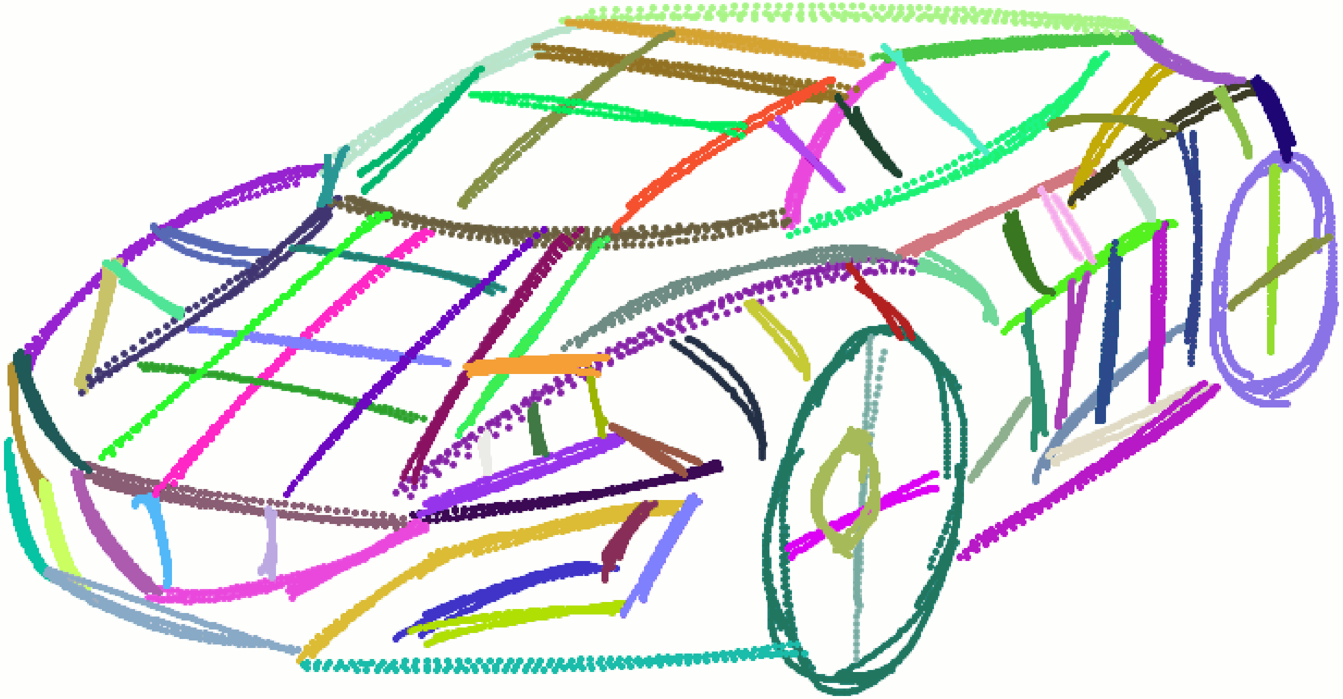




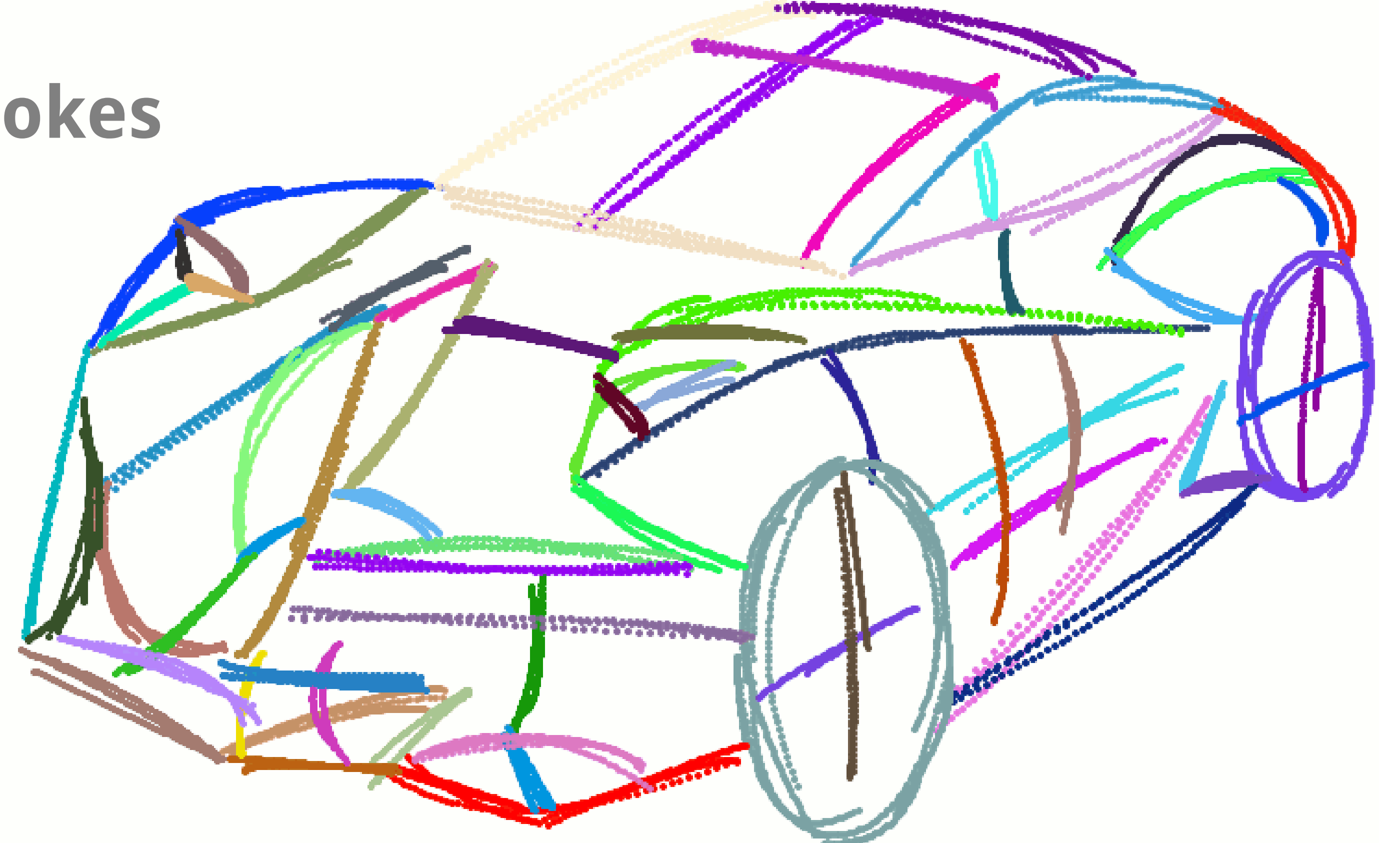
With Bezier approximation



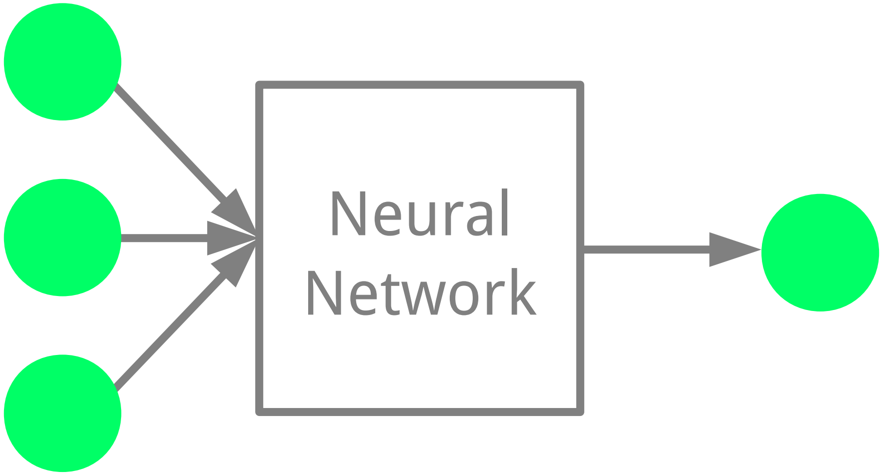
Trainable clustering



Clustered strokes



Neural Network classifier

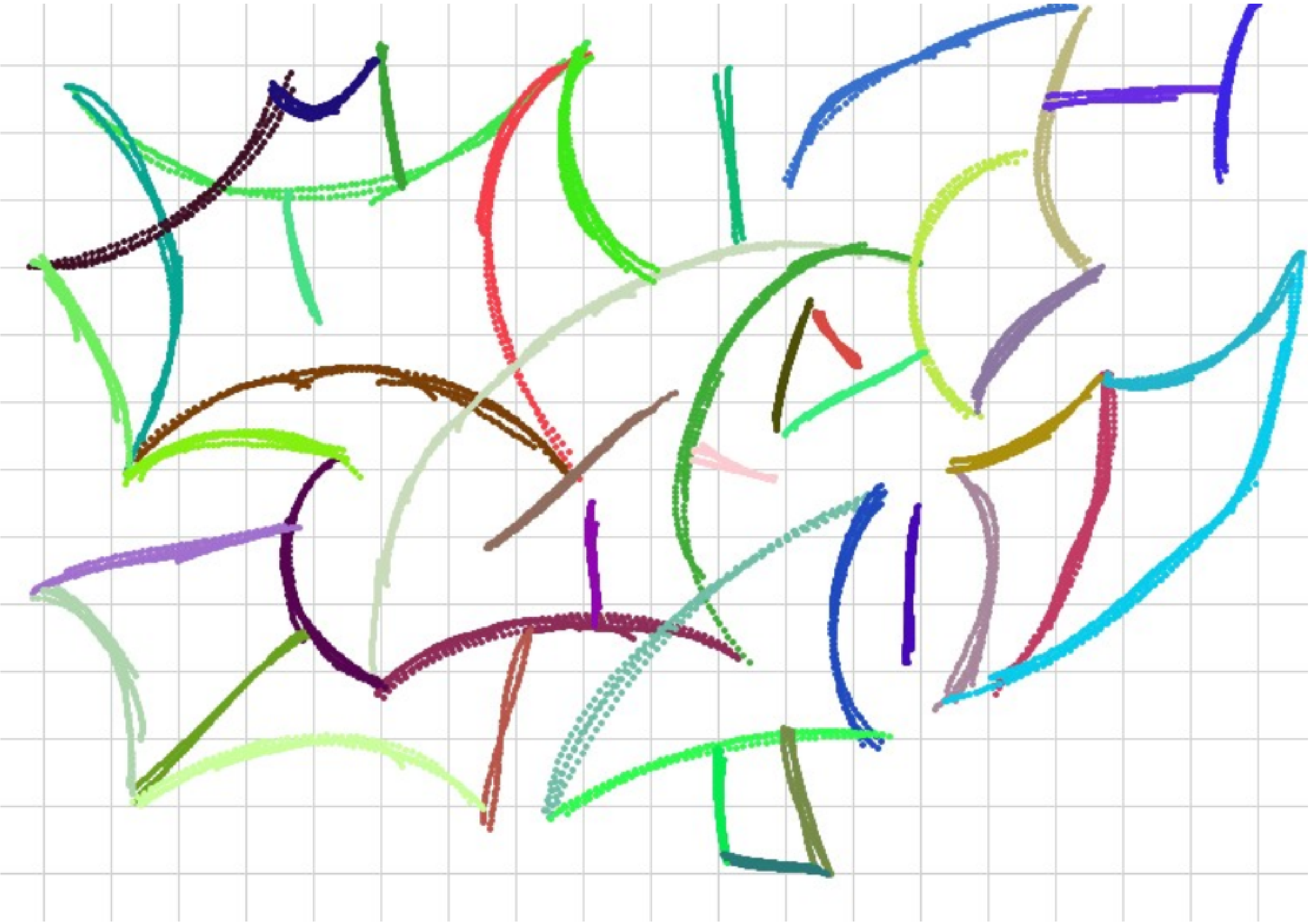


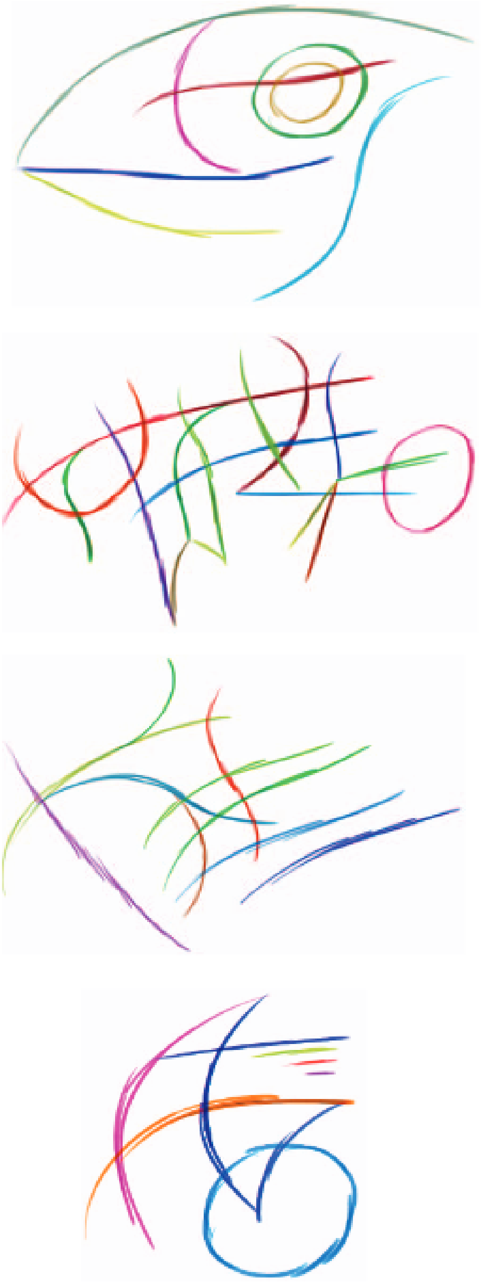
For each pair of lines

0 – same cluster

1 – different cluster

Training set





Incoming sketches are normalized to the endpoints box

Training on dataset drawn by a specific designer provides better accuracy, considering specifics of his drawing style.

Features: distance, angle, discontinuity

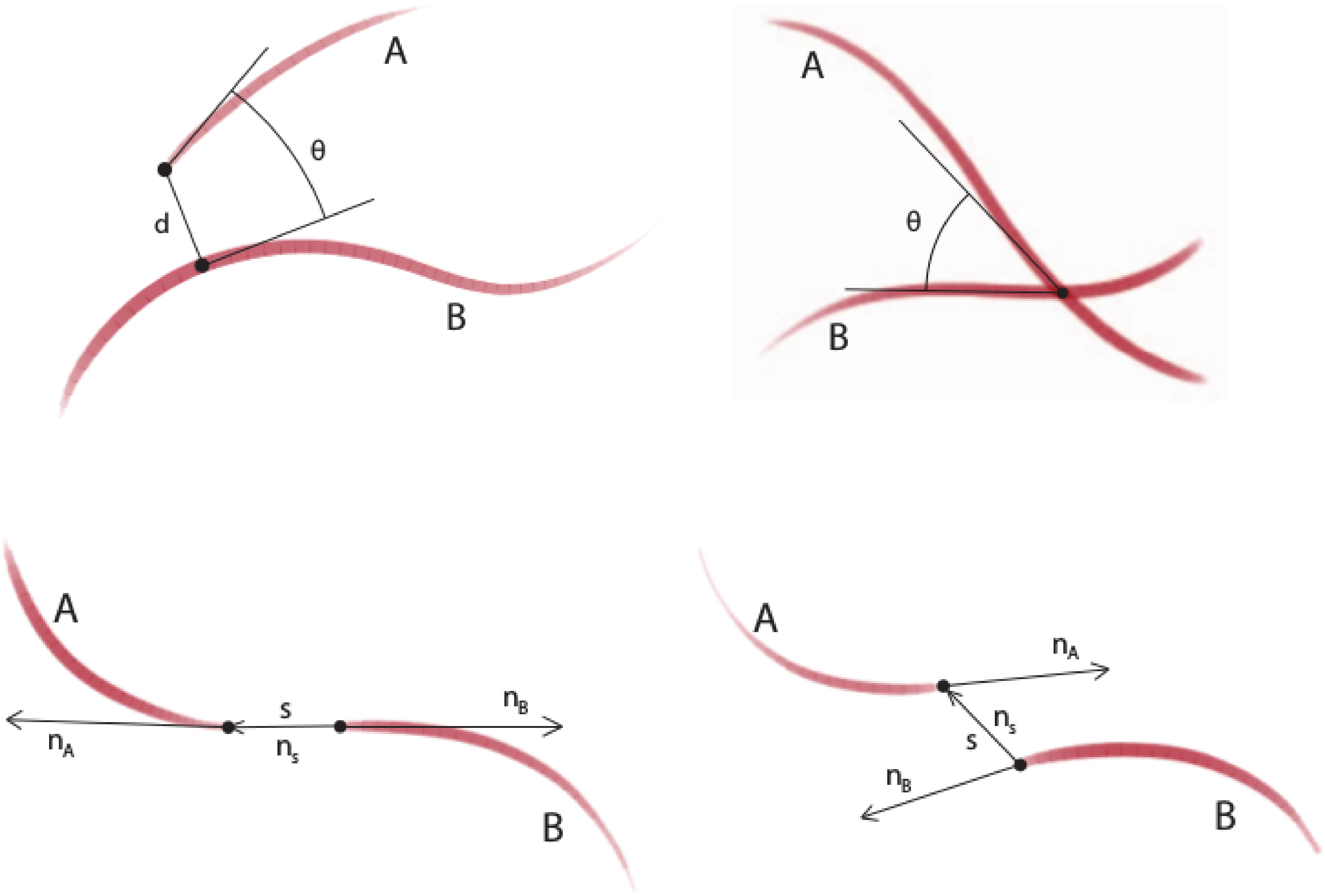
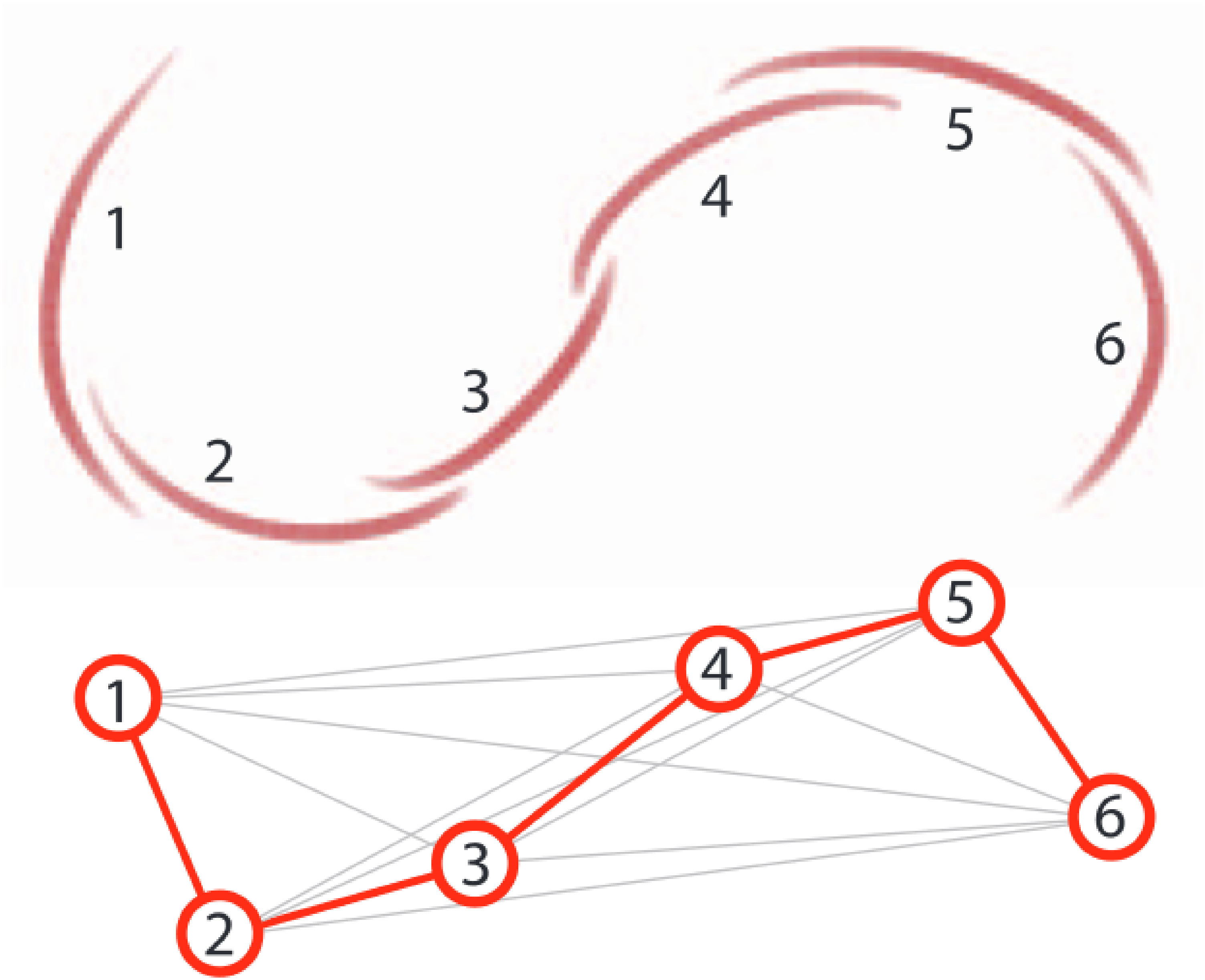


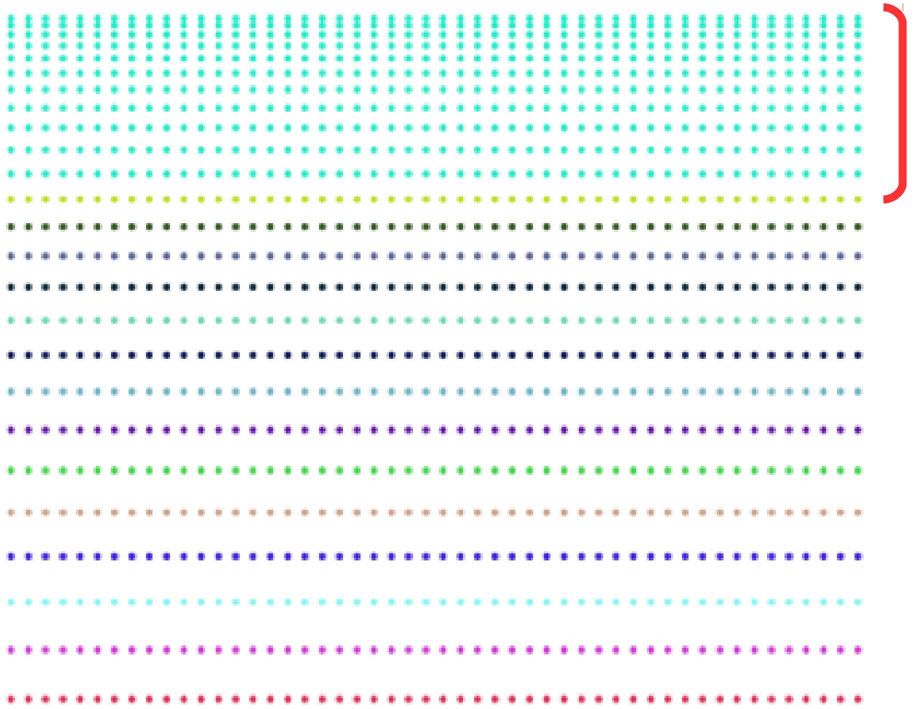
image credit: vdel.me.cmu.edu/publications/2011ieee/paper.pdf



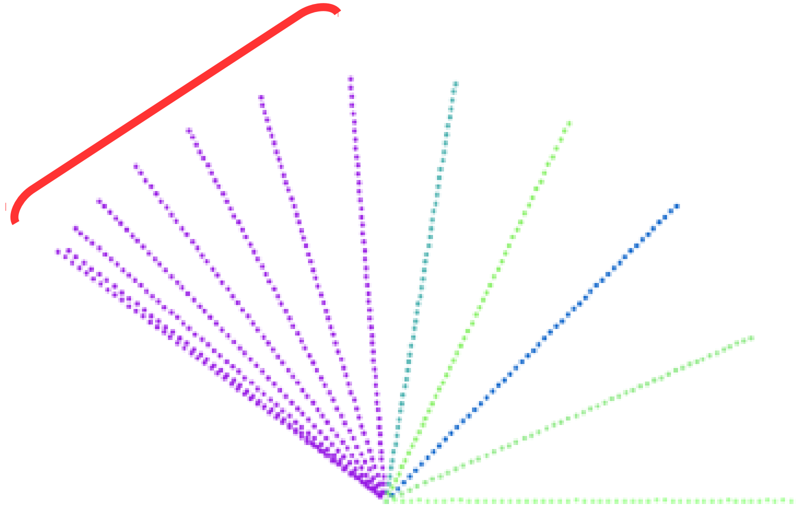
A direct computation of the training features between distant strokes such as 1 and 6 will give a large distances.

image credit: vdel.me.cmu.edu/publications/2011ieee/paper.pdf

Clustering results



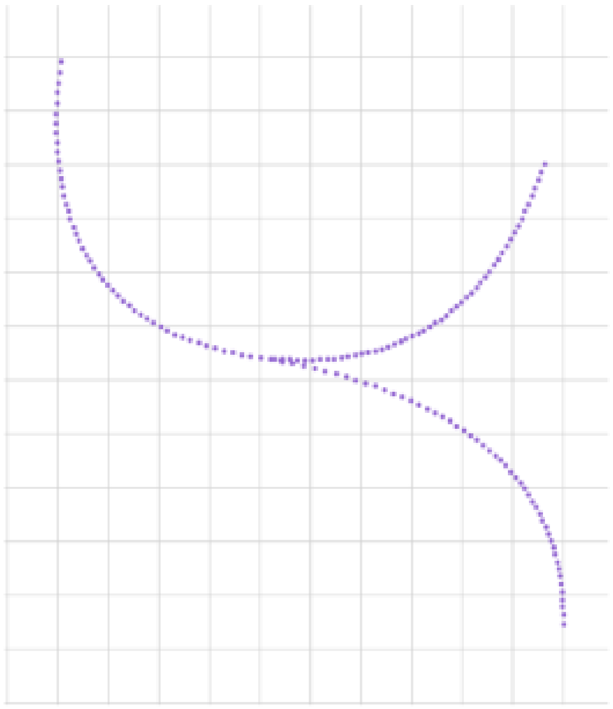
Clustered parallel lines. Each color represents a single cluster.



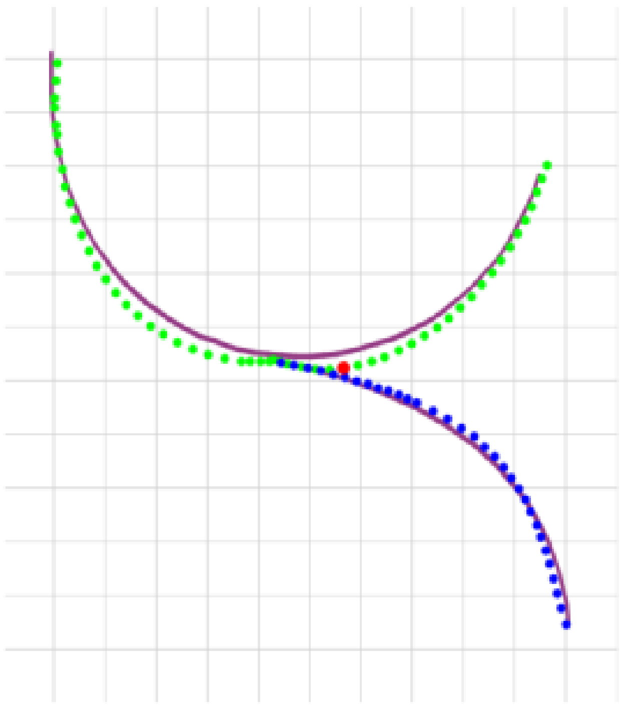
Clustered rotated lines. Each color represents a single cluster.

Greedy algorithm

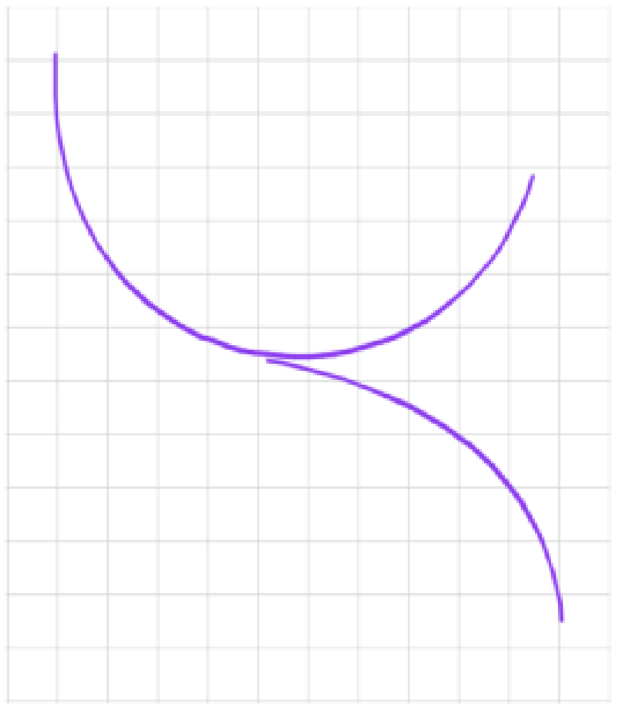
Branch splitting



Example of a single cluster of the strokes



Bifurcation point and detected skeletons.



Final result

Minimum spanning tree

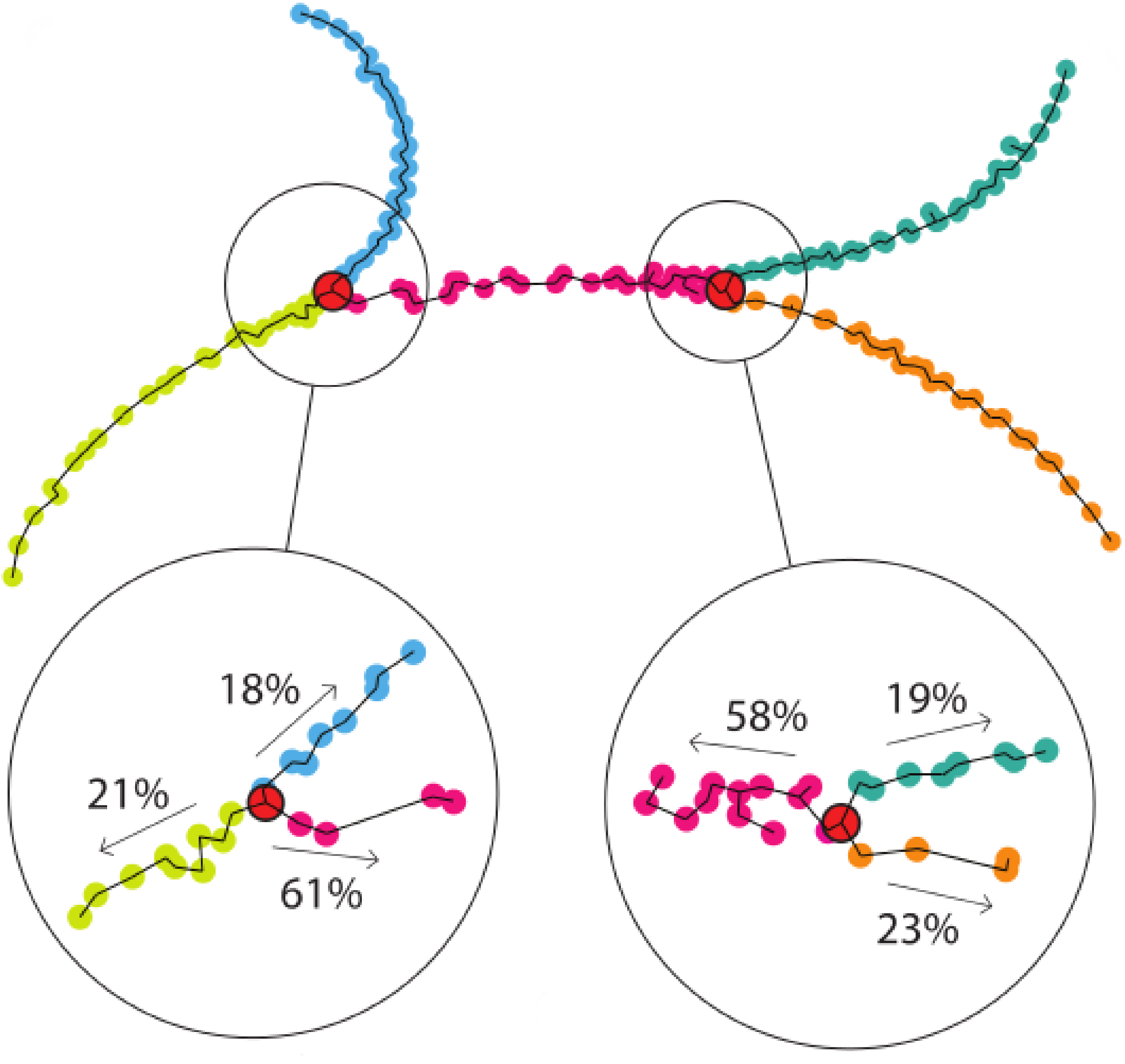
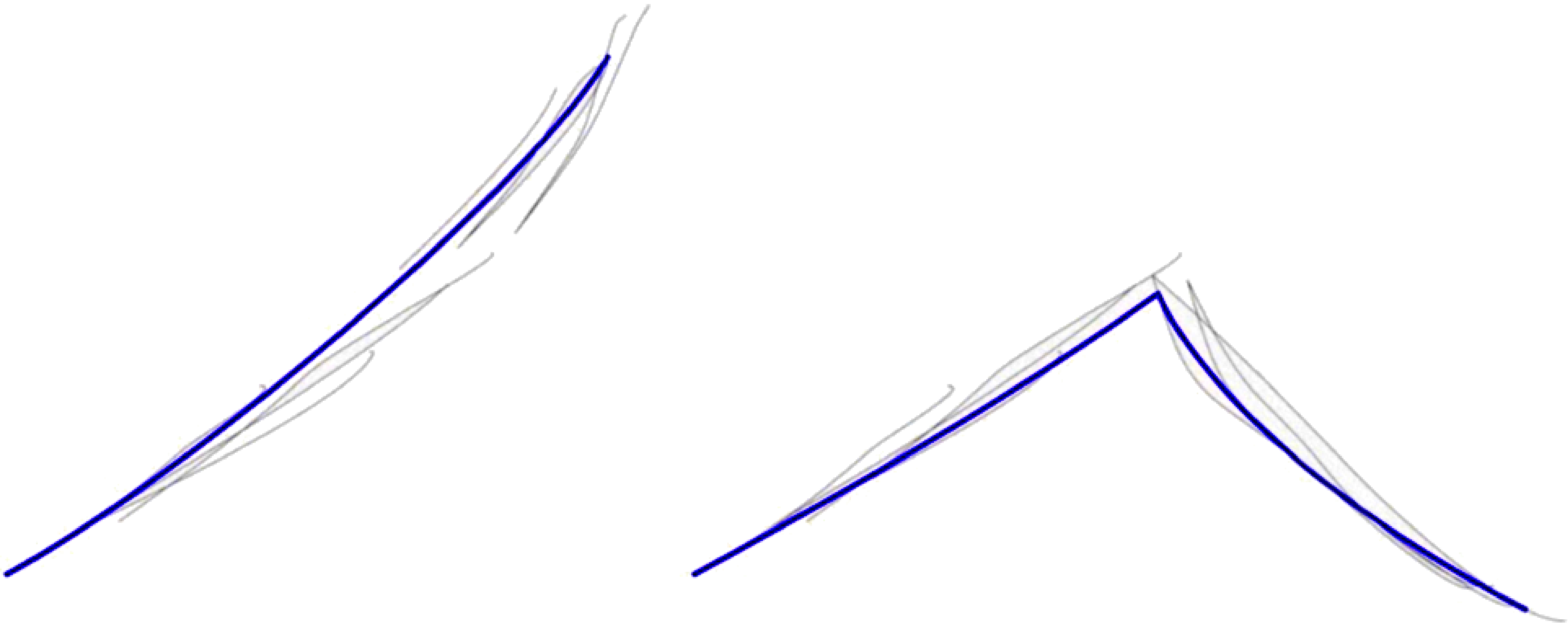
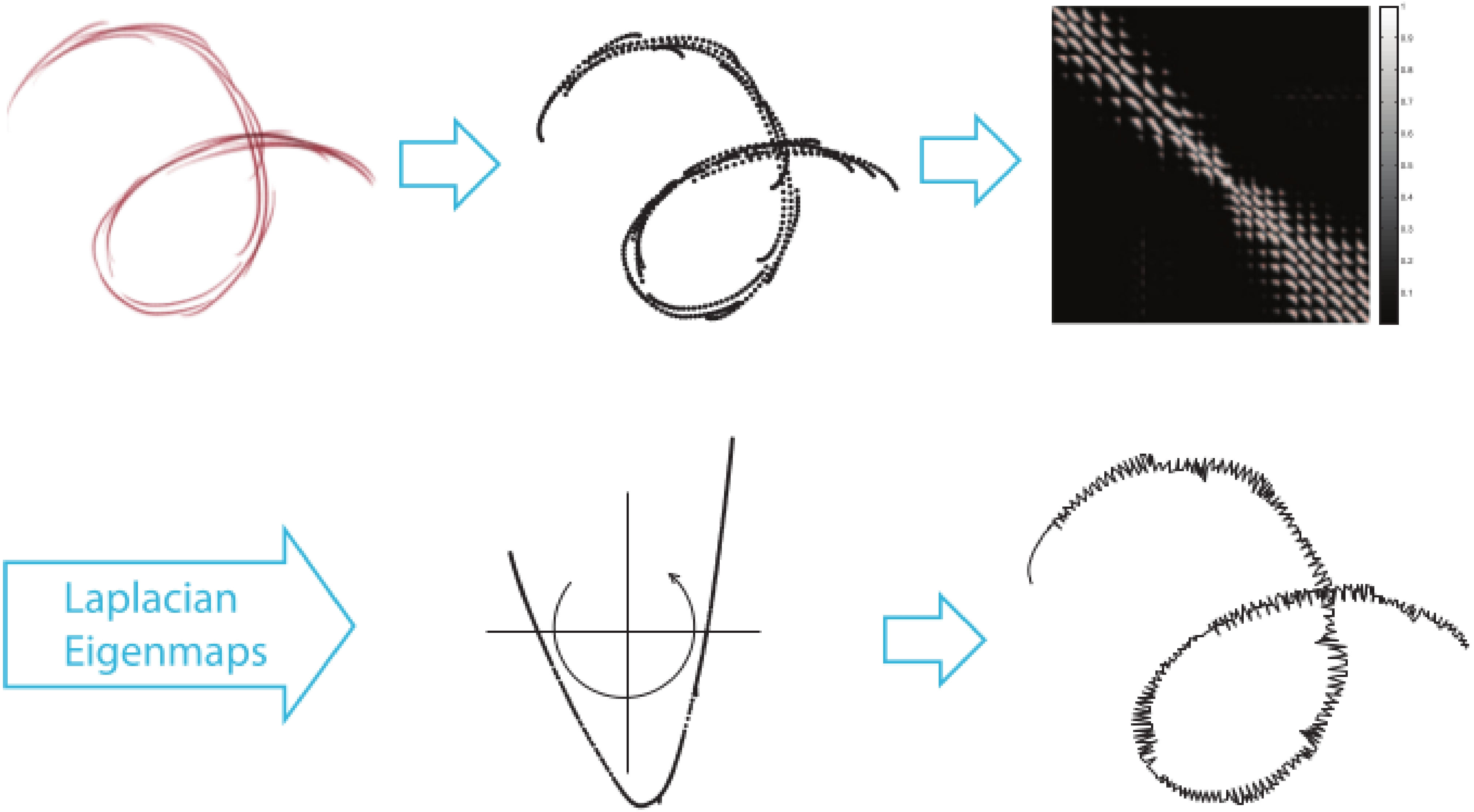


image credit: vdel.me.cmu.edu/publications/2011ieee/paper.pdf

Point reordering



Convert strokes to beautiful lines

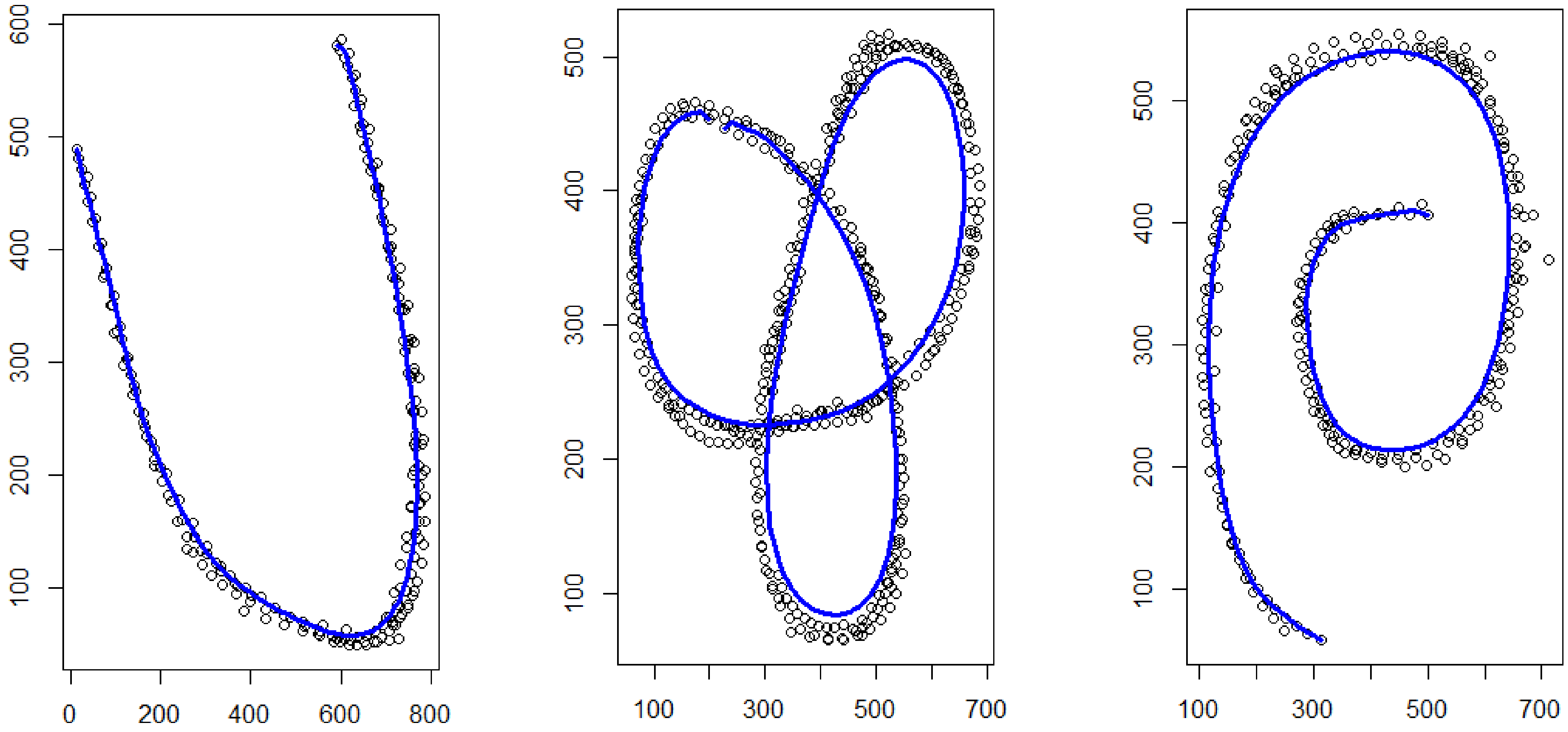


Laplacian Eigenmaps

Strokes → Unordered points → Affinity matrix →
Laplacian Eigenmaps (spectre) →
Ordered points in spectral domain → Result ordering

image credit: vdel.me.cmu.edu/publications/2011ieee/paper.pdf

Curve fitting / Smoothing



Fourier Transform smoothing or Savitzky-Golay smoothing https://youtu.be/4R3ELbDf6vU

Used materials, links and resources

1 http://elekslabs.com/2016/09/designing-apparel-neural-style-transfer.htm

2 http://vdel.me.cmu.edu/publications/2011ieee/paper.pdf

3 https://amyrobinson.me/2015/07/12/googles-deep-dream-on-instagram/

4 https://github.com/google/deepdream

5 http://boingboing.net/2016/04/28/sketch-simplifying-neural-netw.html

6 http://hi.cs.waseda.ac.jp/~esimo/en/research/sketch/

7 https://github.com/jcjohnson/neural-style

8 https://en.wikipedia.org/wiki/B%C3%A9zier_curve

9 http://vector-conversions.com/vectorizing/raster_vs_vector.html

10 http://www.jasonkenison.com/2016/06/69/Vector-vsRaster-Images-for-We

Let’s stay in touch:

Facebook

https://www.facebook.com/neverdraw

LinkedIn

https://www.linkedin.com/in/awesomengineer

Github

https://github.com/spaceuniverse

Thanks ^_^

http://cdn.gymnasticstracks.com/wp-content/uploads/2015/09/httyd.jpg