

Fundamentals and Applications of Sketch Processing

Setups & Motivations

Misha & Chenxi



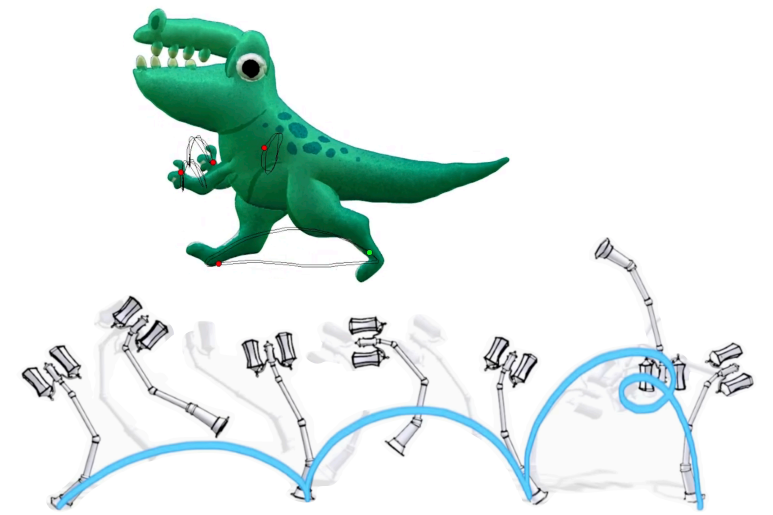
UNIVERSITY OF
TORONTO



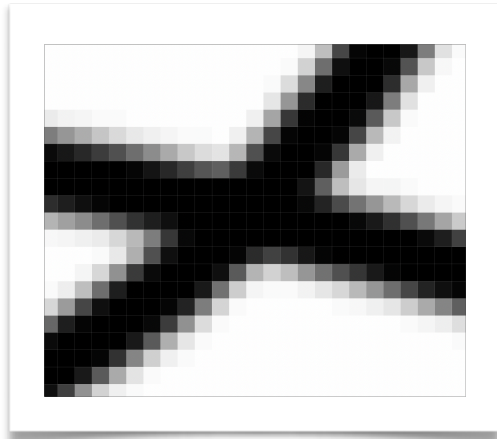
Tracking Samples



2D Sketches



Models & Animations



Raster Samples

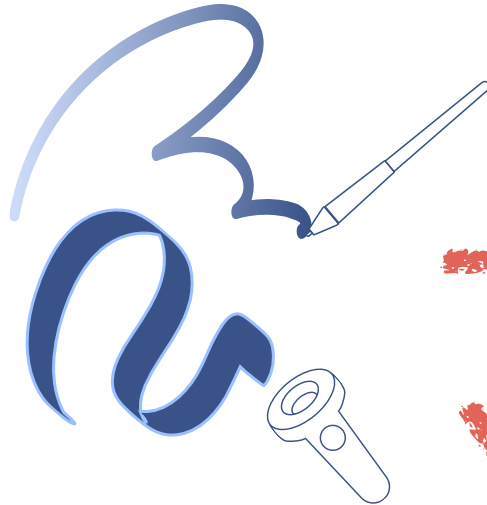


3D Sketches

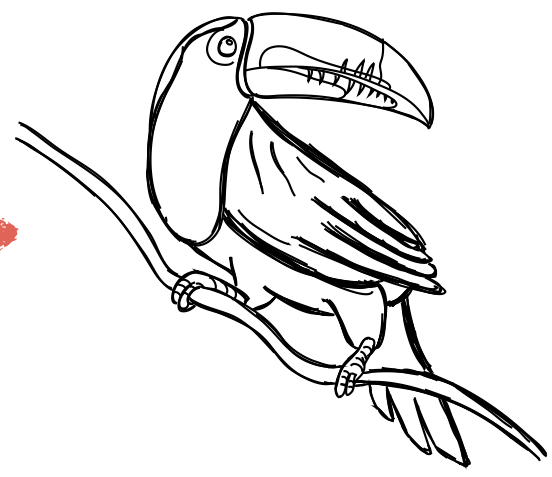


Data for Learning

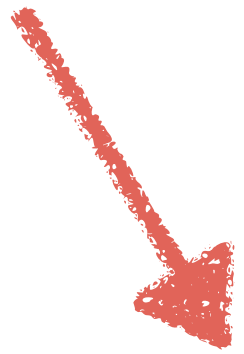
Creation Process



Tracking Samples



2D Sketches



3D Sketches

Stroke Construction & Drawing Interface



Creation Process

Digital Drawing Devices



Sutherland's Sketchpad
(1963)



Pen and touch display
(photo taken in 2019)

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Various drawing tablets
(photo taken in 2012)

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2D Drawing
Tablets



HTC Vive Pro 2
(2021)

3D Drawing
Systems

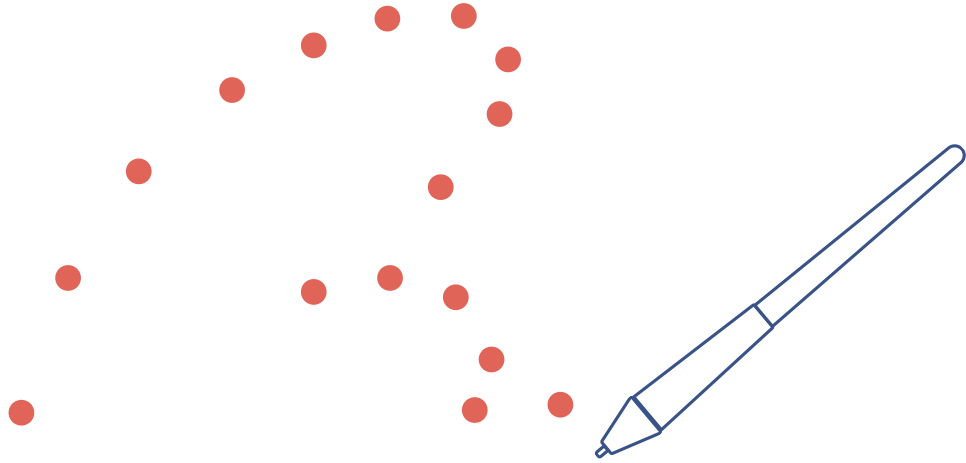


Sutherland's HMD
(1968)



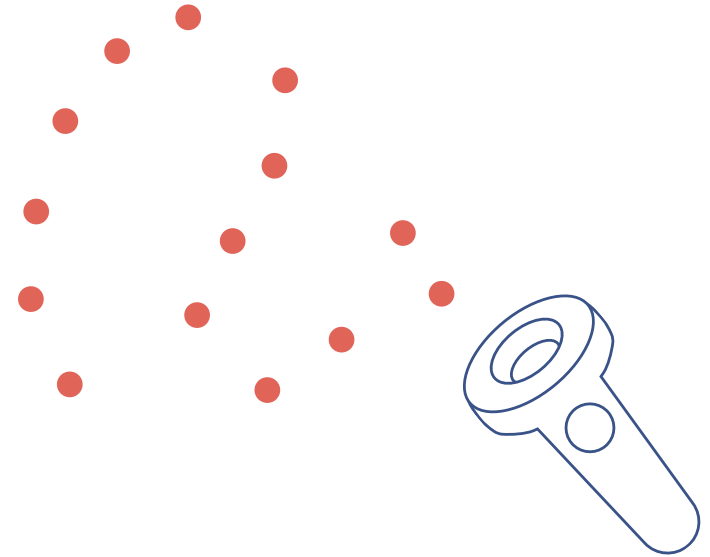
Apple Vision Pro
(2024)

Tracking Samples



2D sample sequence

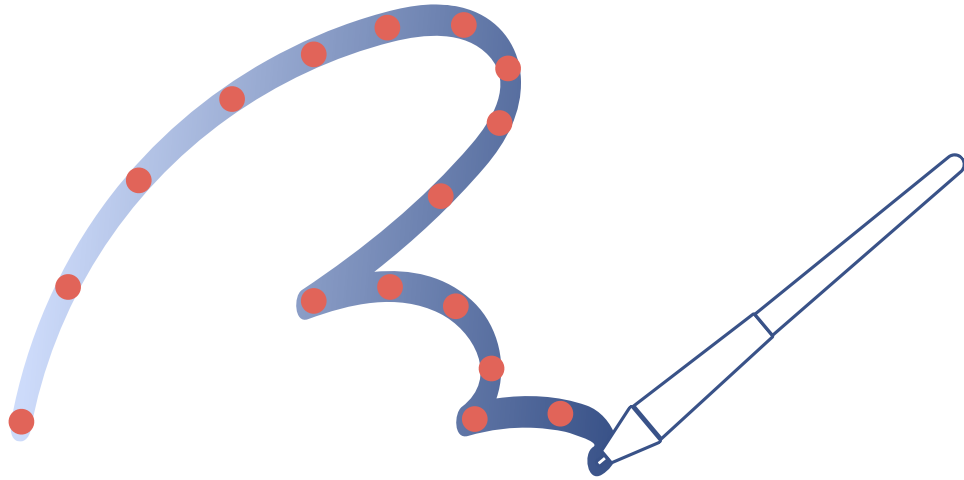
- (x, y)
- Timestamp
- Pressure
- Tilt



3D sample sequence

- (x, y, z)
- Timestamp
- Orientation

Stroke Representations



2D stroke representations

- Polylines
- Parametric curves
- Splines
- etc.



3D stroke representations

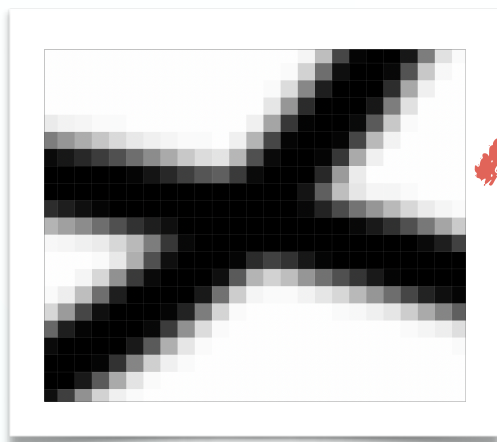
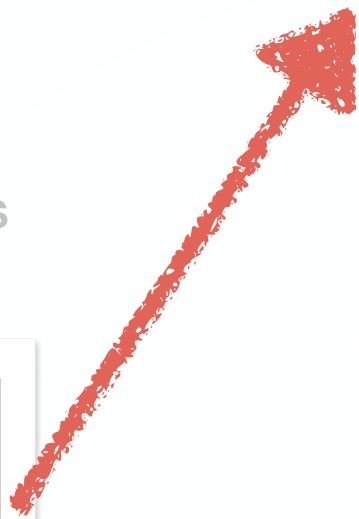
- Tubes
- Calligraphic curves (ribbons)
- etc.



Tracking Samples



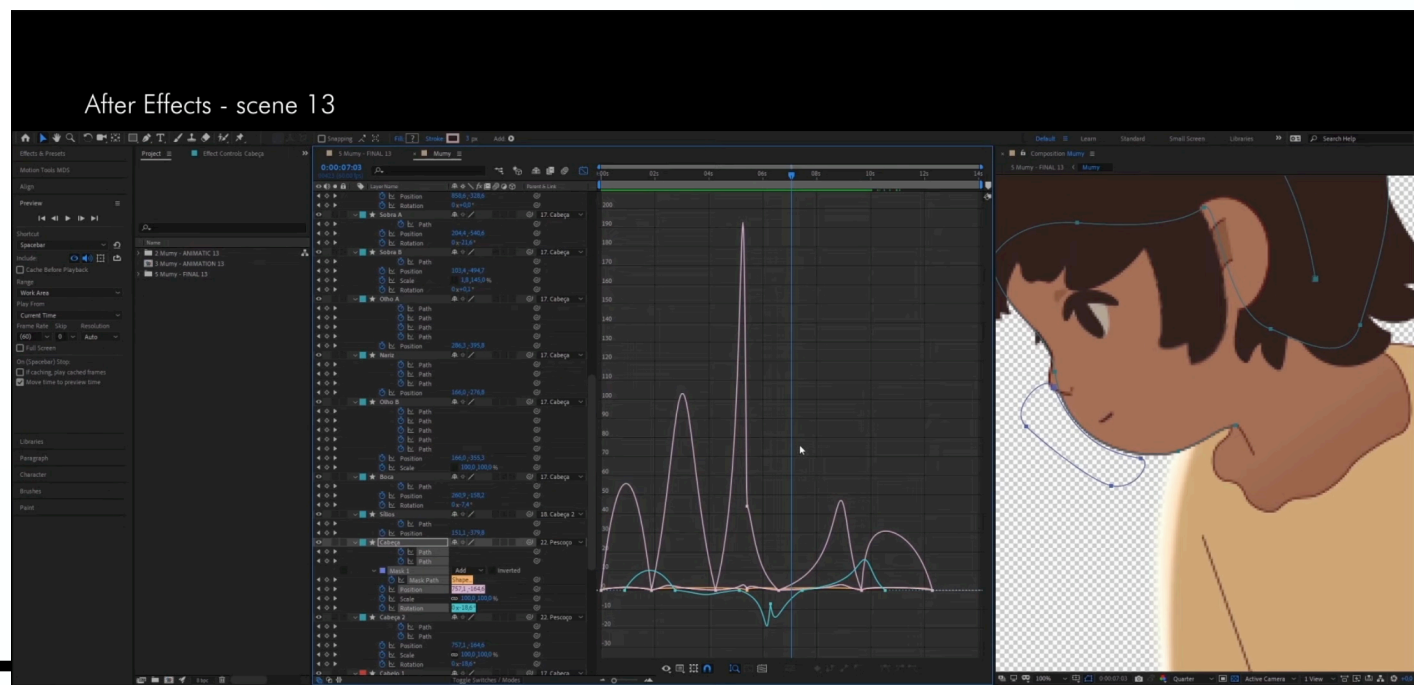
2D Sketches



Raster Samples

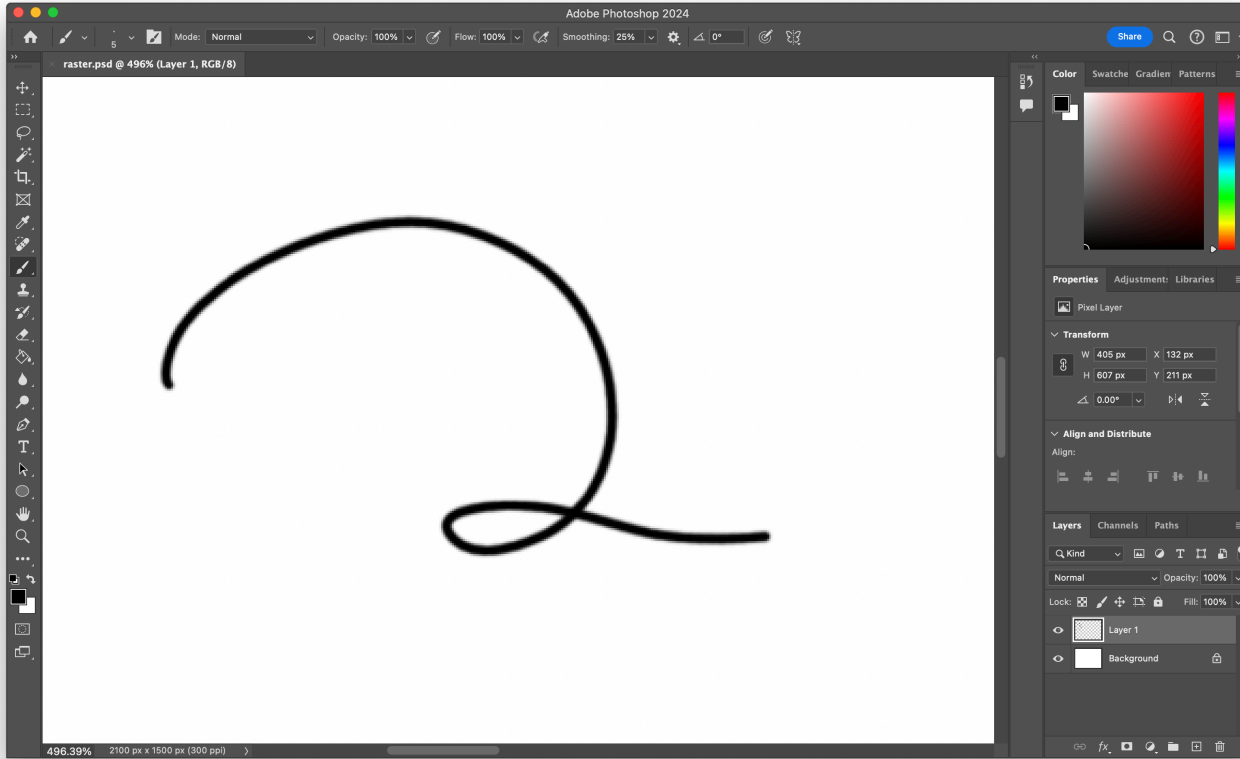
Vectorization

© Victor Ishihara
<https://www.youtube.com/watch?v=T54FRtdmDC8>



Cre

Non-Sequential 2D Samples: Pixels



Digital drawings



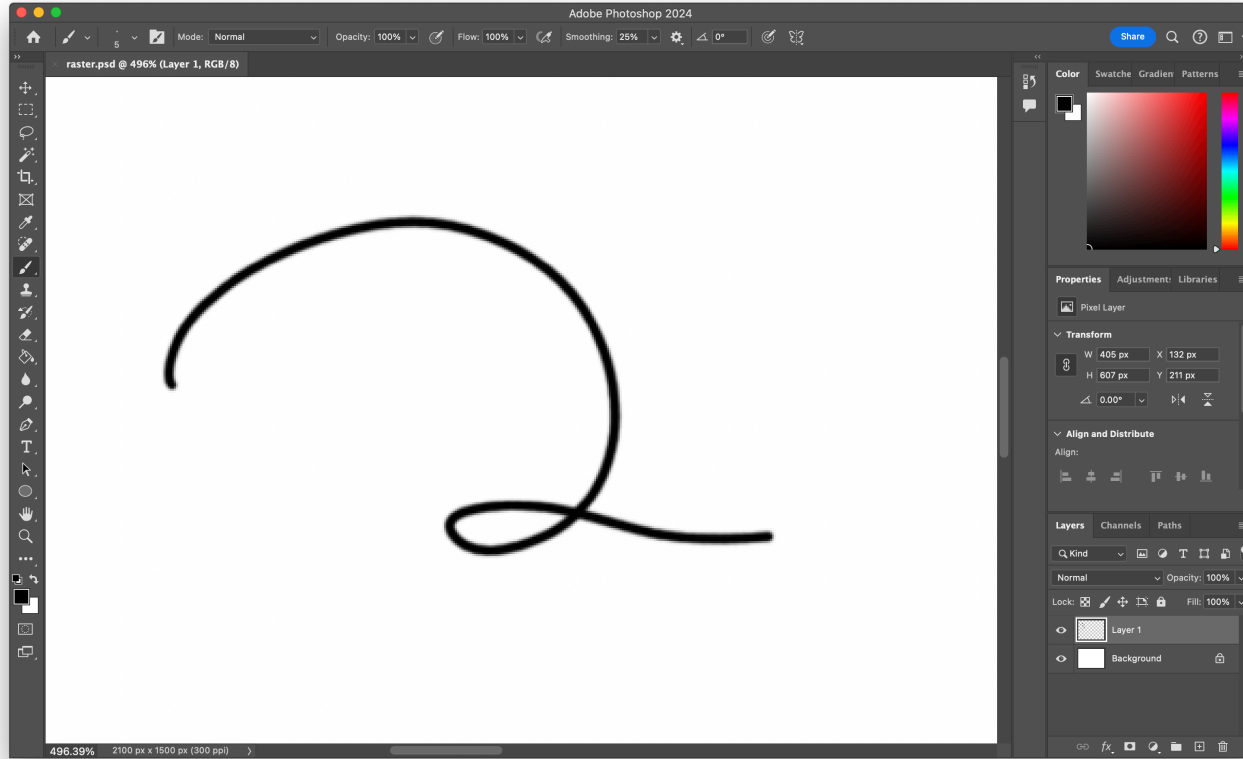
© Myriam Lasserre, CC-BY-SA-4.0



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Digital scans

Non-Sequential 2D Samples: Pixels



Digital drawings



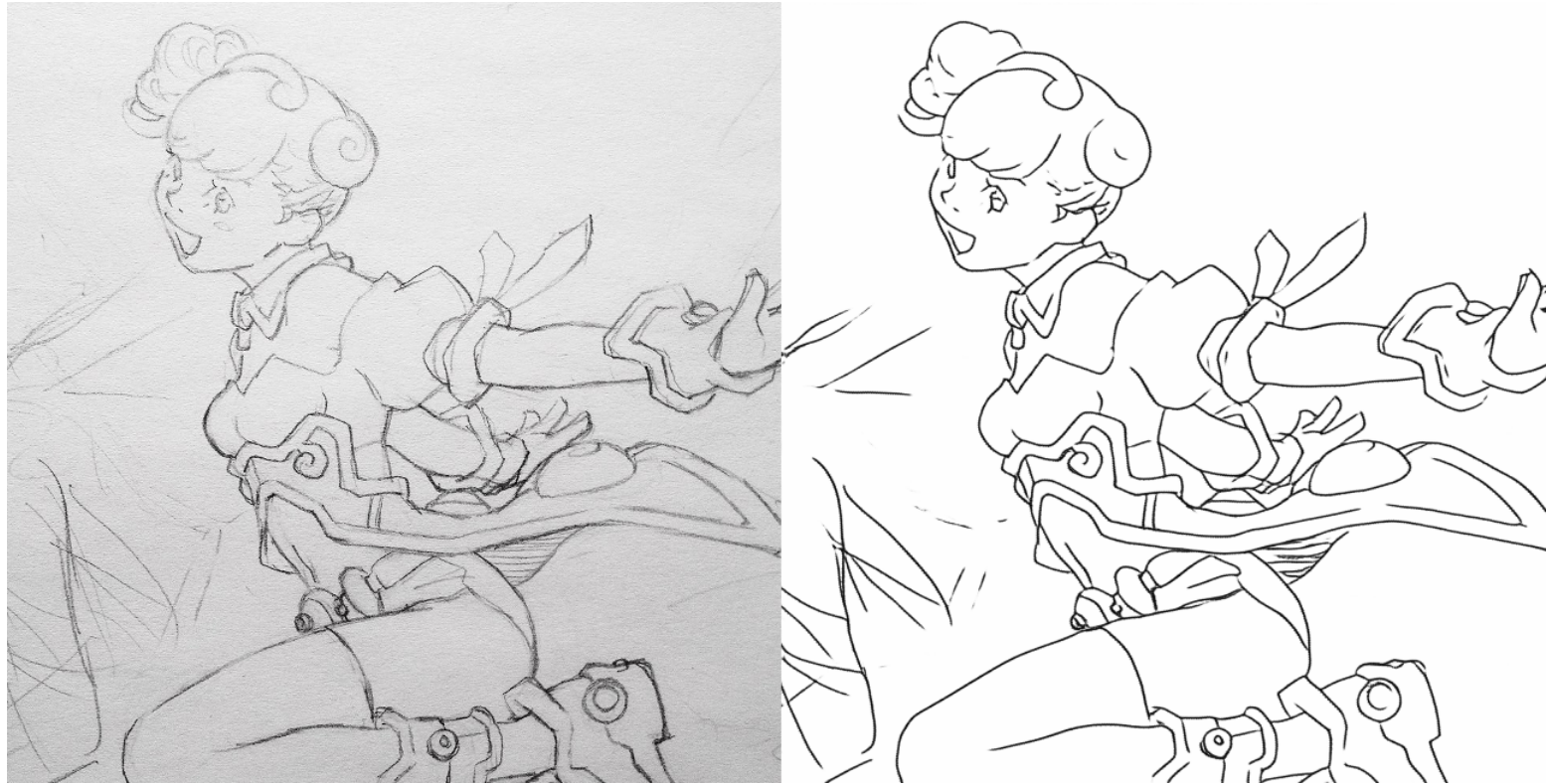
Clean

© Myriam Lasserre, CC-BY-SA-4.0

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Digital scans

Raster Sketch Cleanup

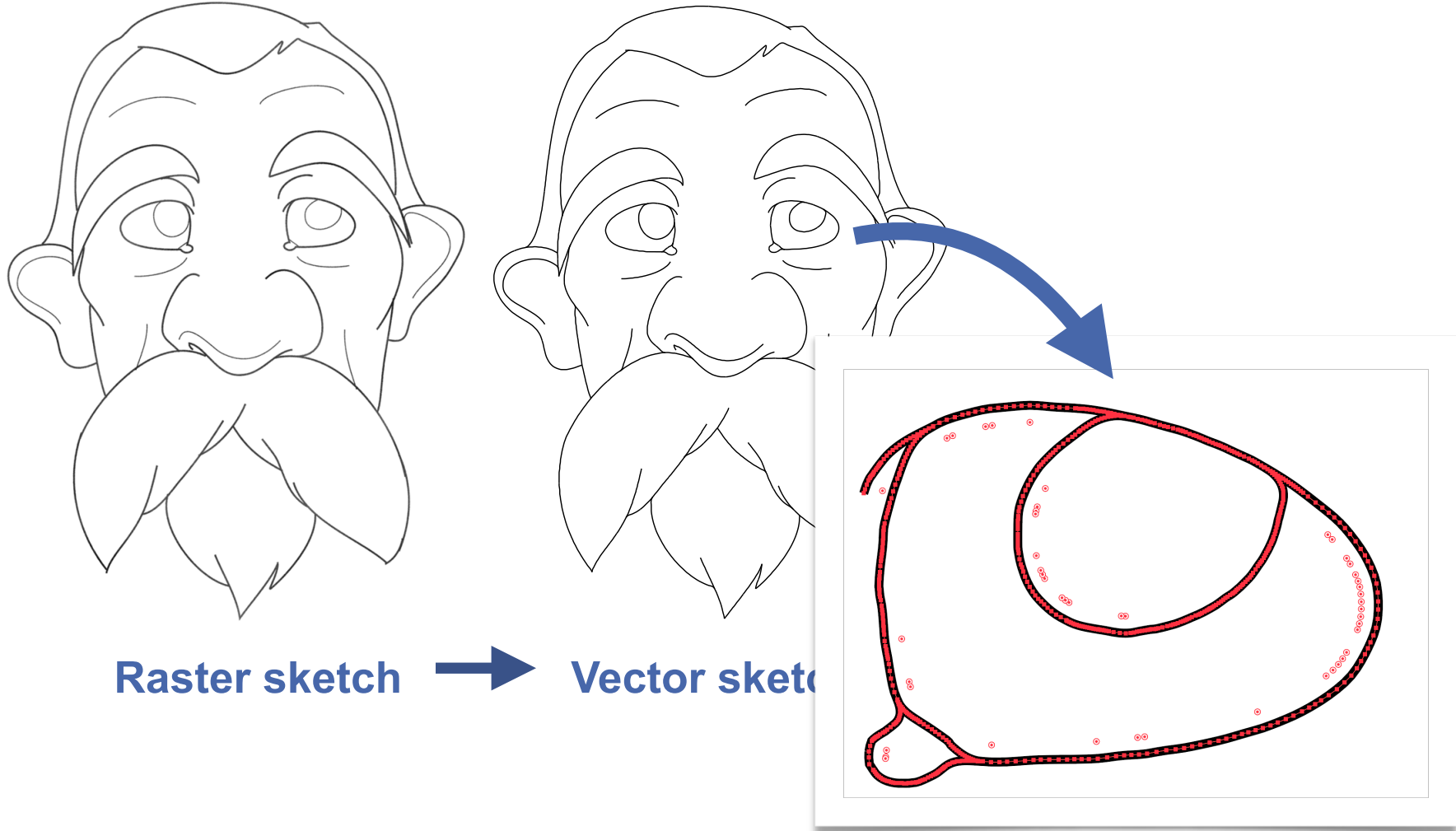


Raster rough
sketch

Raster clean
sketch

Good for preprocessing

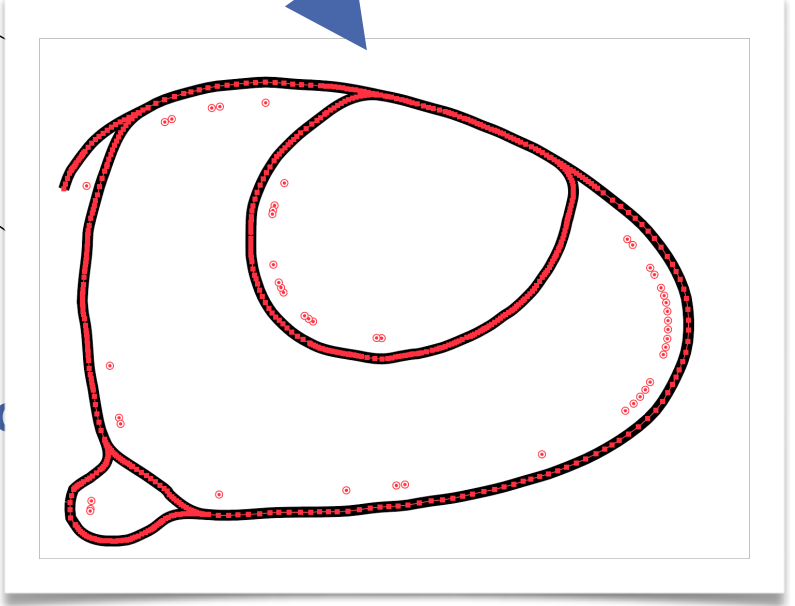
Sketch Vectorization



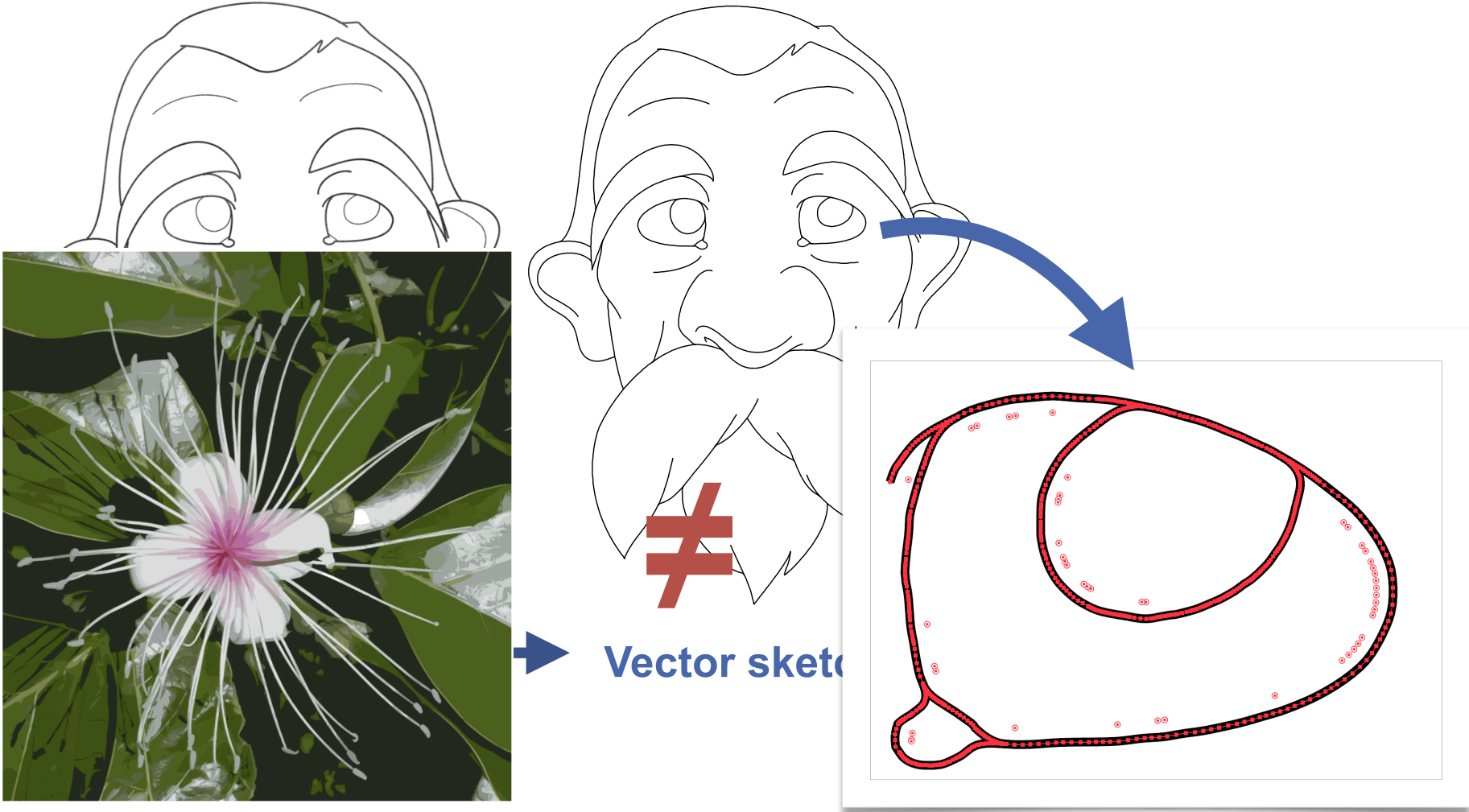
Raster sketch



Vector sketch

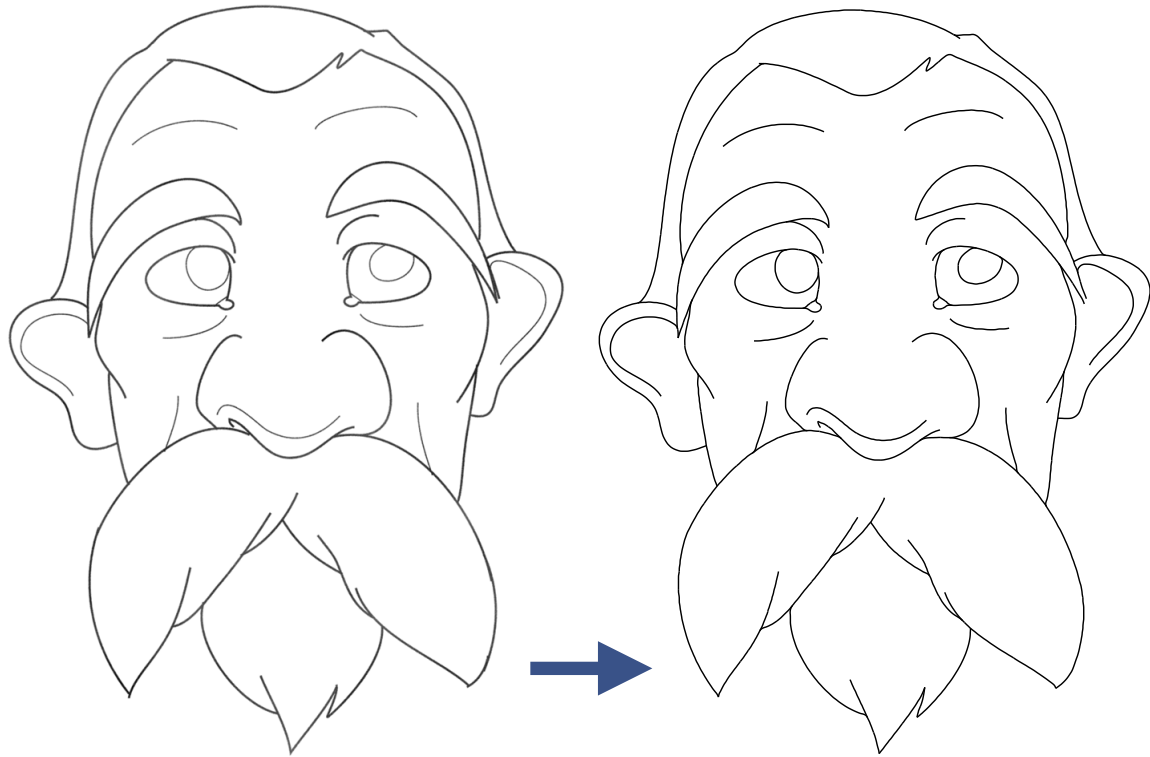


Sketch Vectorization

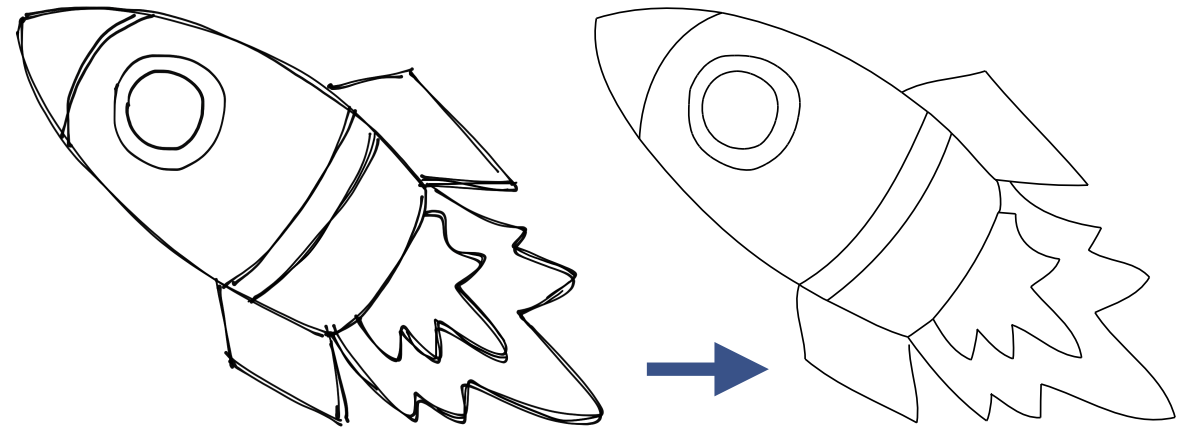


[Li et al. 2020], DiffSVG

Sketch Vectorization



Clean sketch



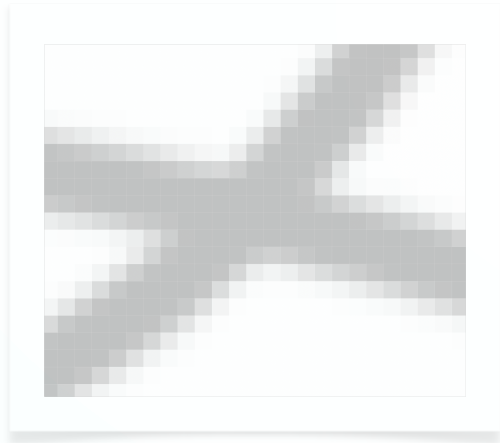
Overdrawn sketch



Tracking Samples



2D Sketches

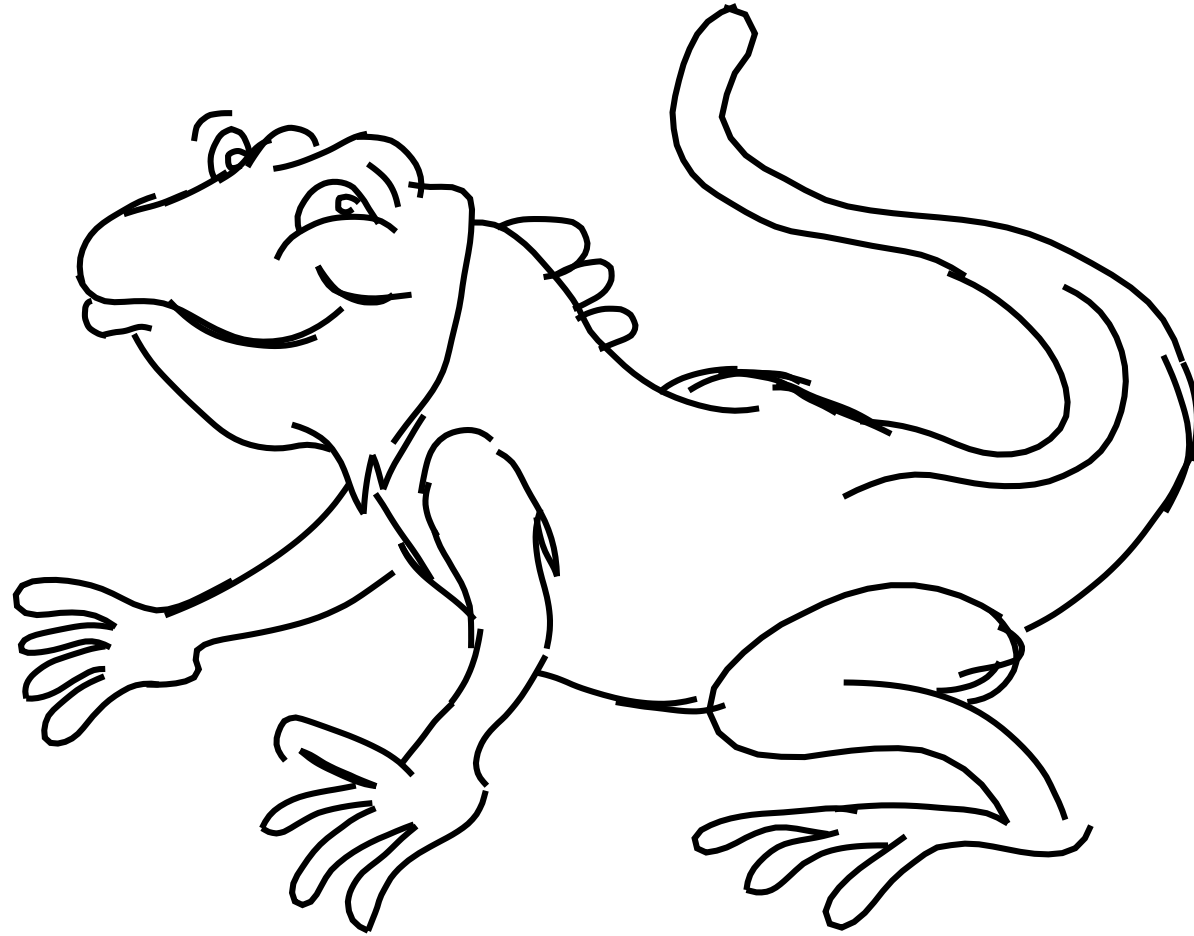


Raster Samples

**Sketch Cleanup &
Flat Colorization**

Creation Process

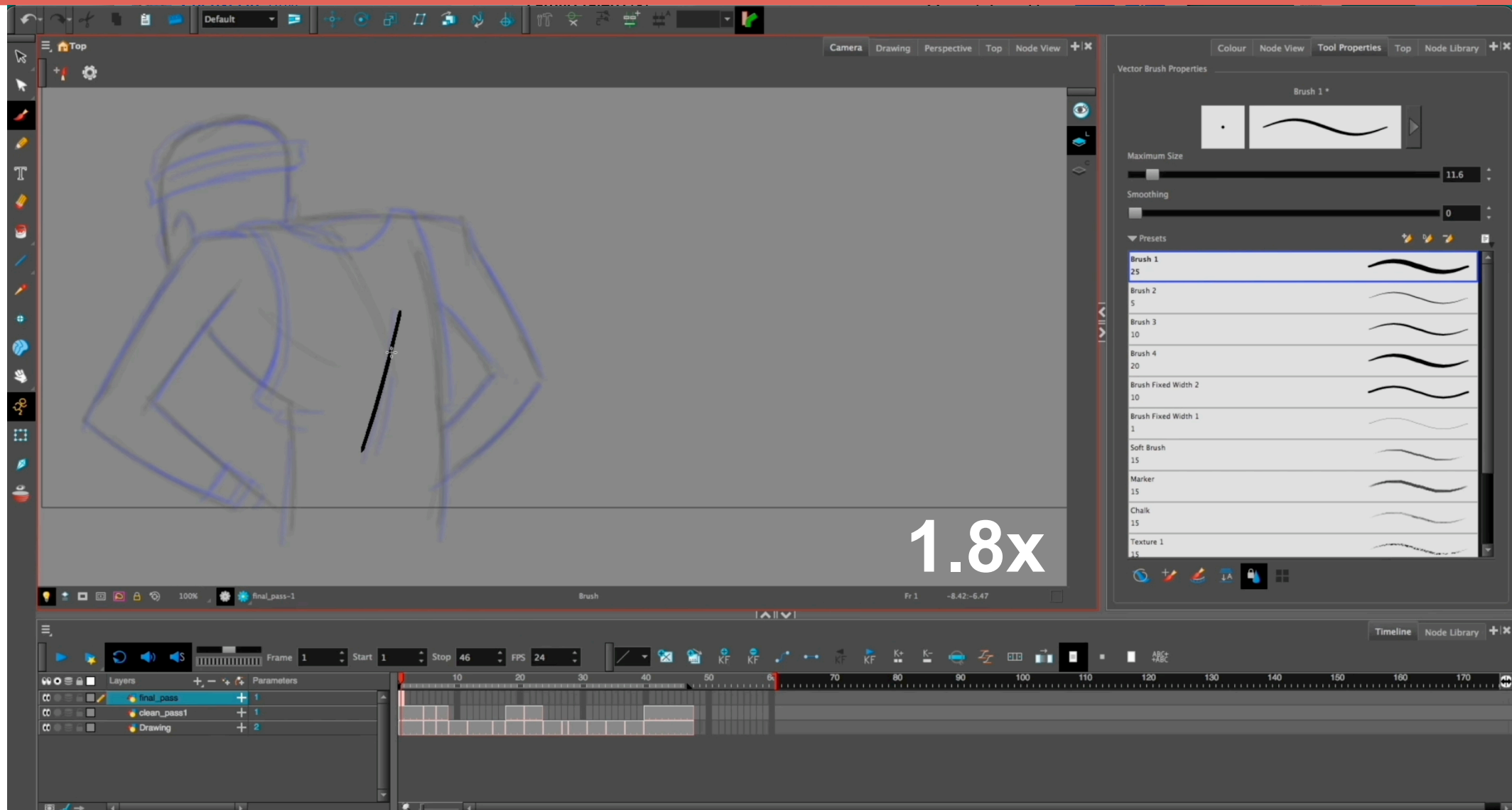
Typical Sketches



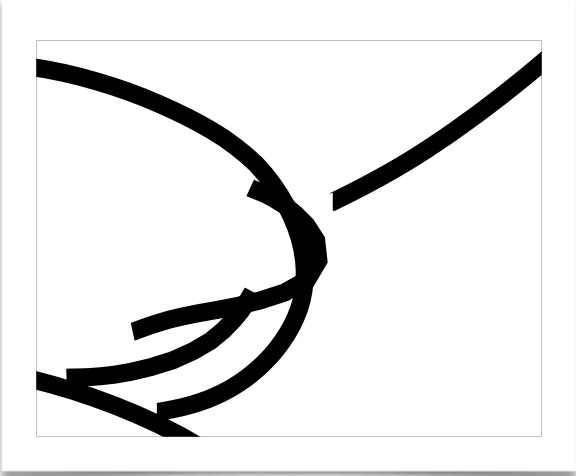
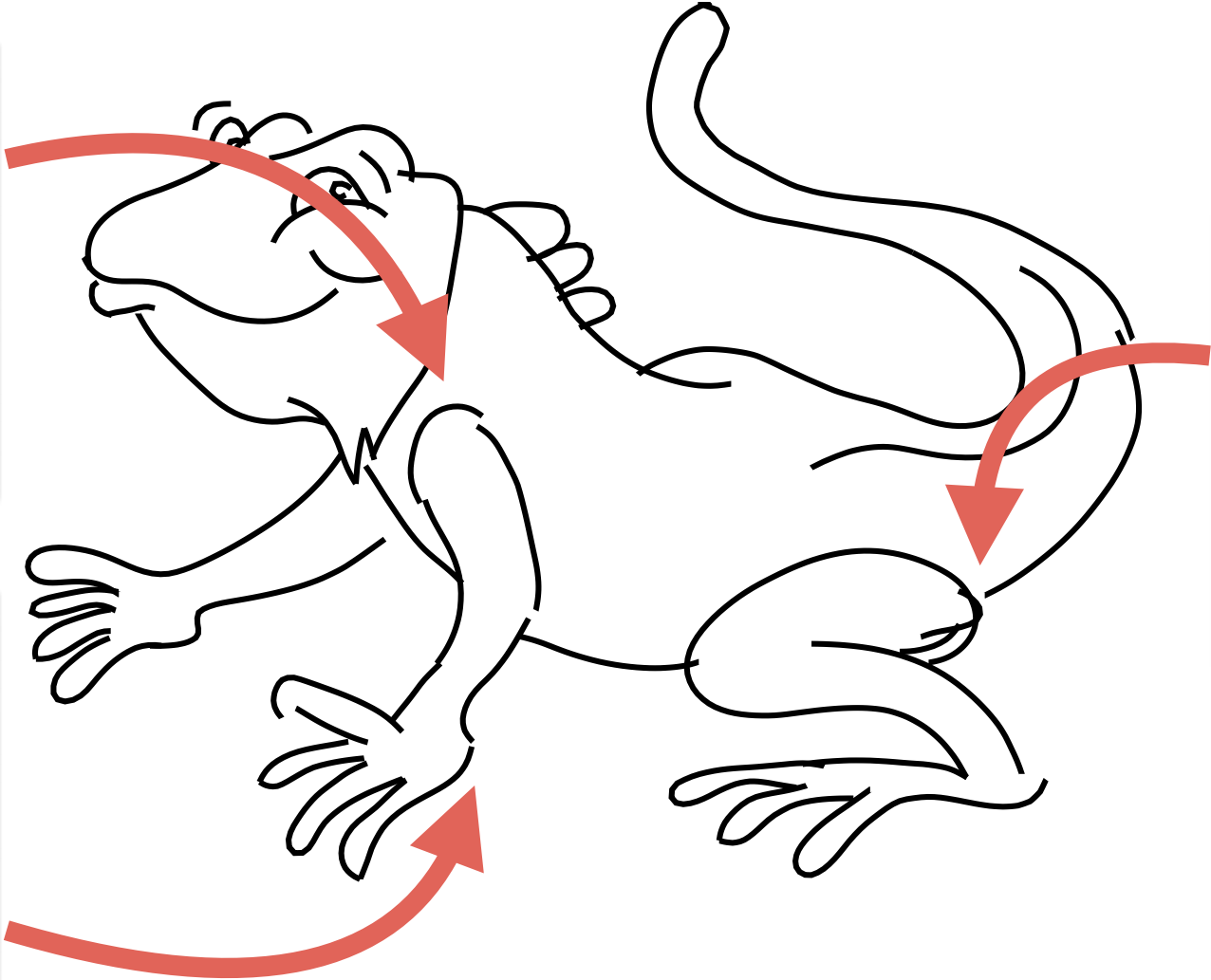
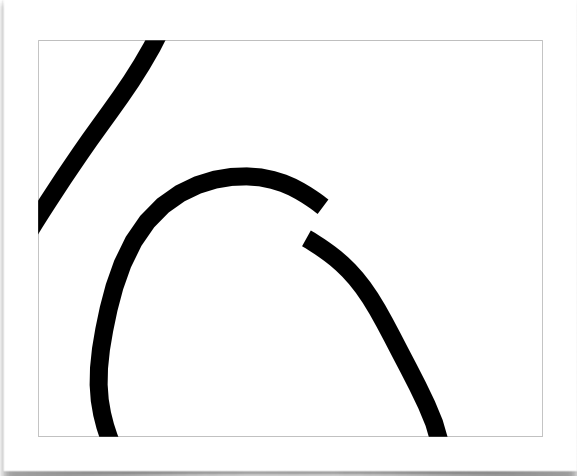
Typical Sketches



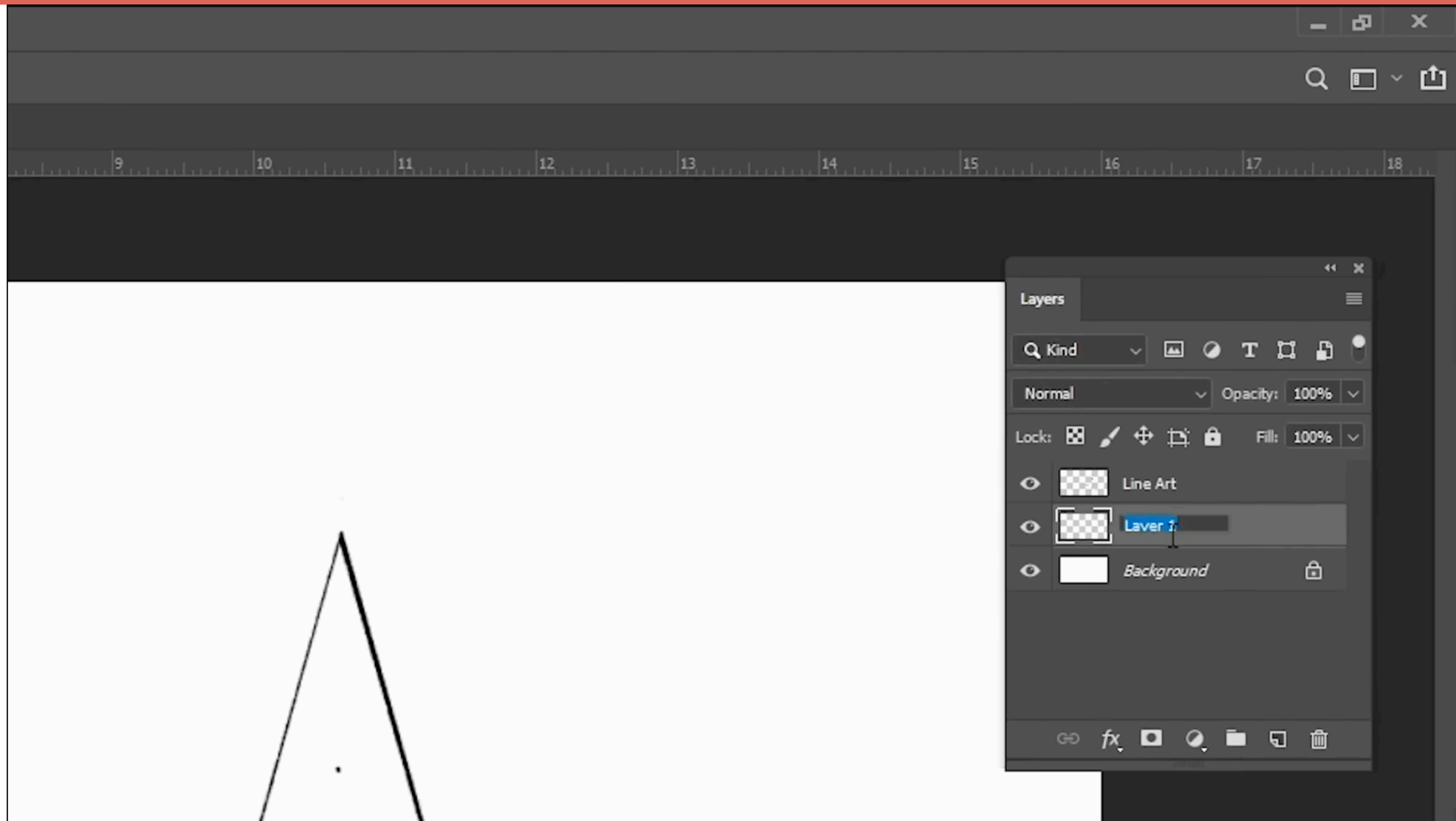
Sketch Topology: Cleanup/Simplification/Consolidation



Typical Sketches

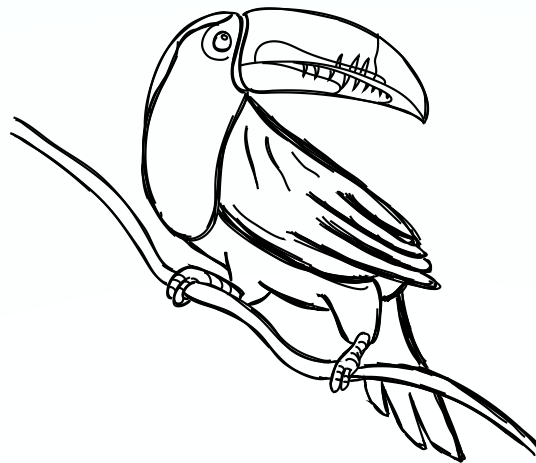


Sketch Topology: Flat Colorization/Junction Reconstruction





Tracking Samples



2D Sketches



Raster Samples



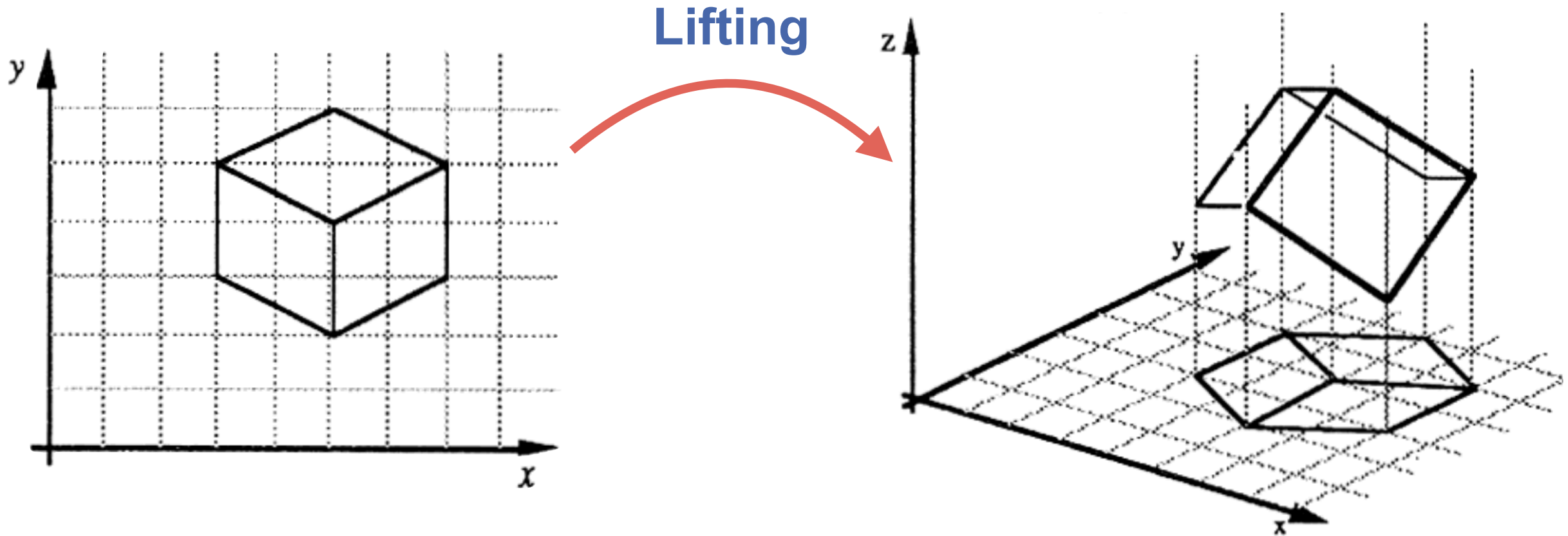
3D Sketches



Sketch Lifting

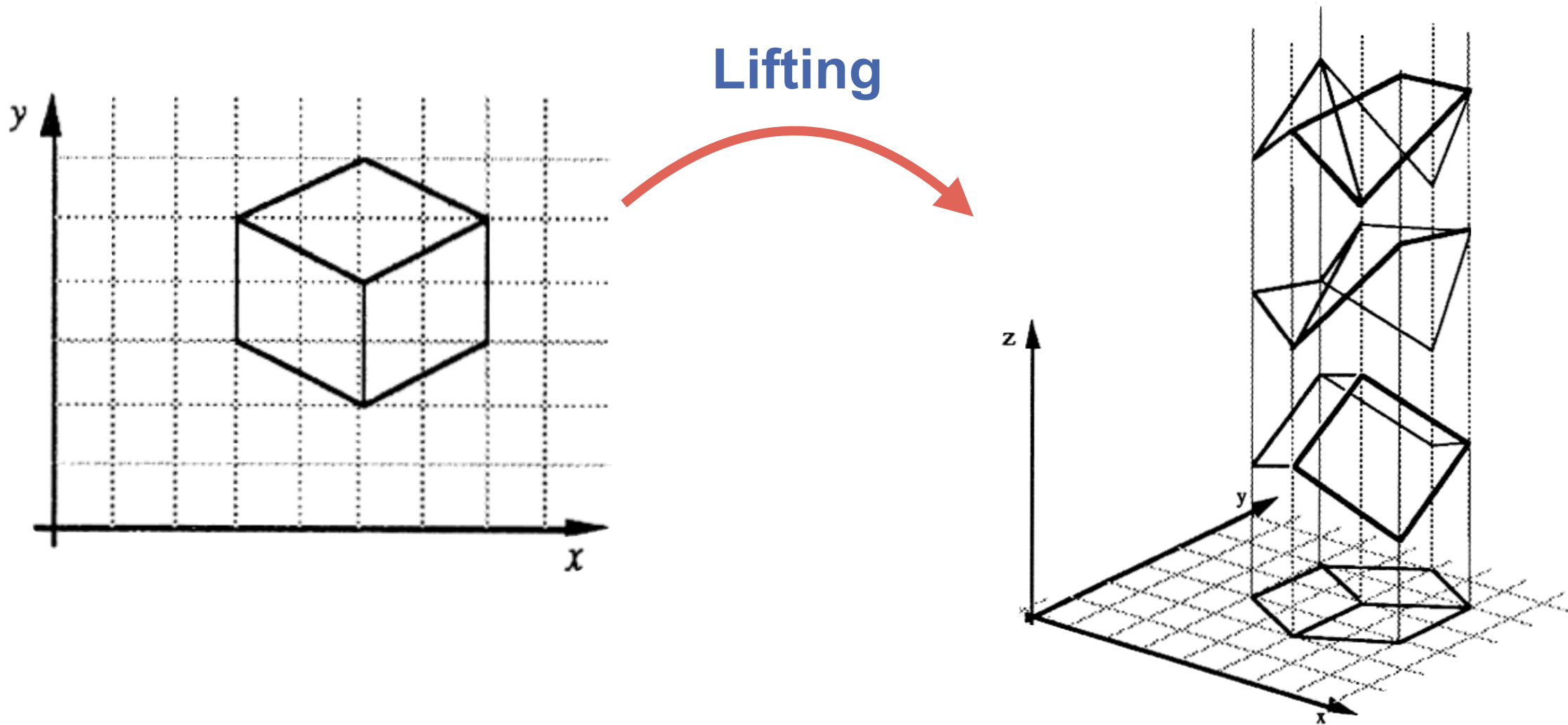
Creation Process

Projection Ambiguity in Single Sketch



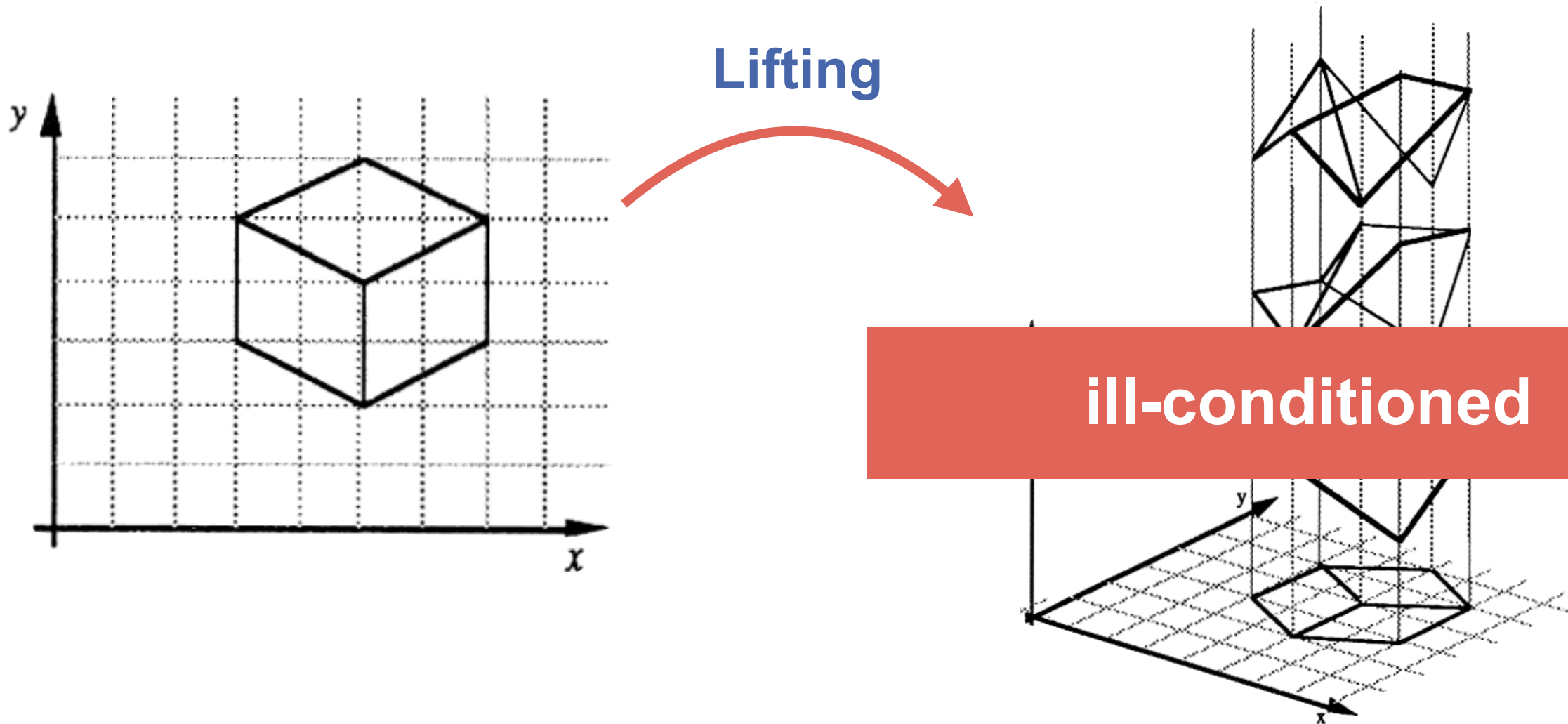
[Sinha et al. 1993]

Projection Ambiguity in Single Sketch

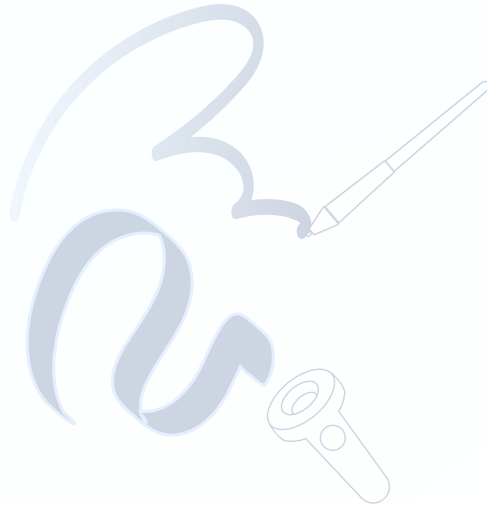


[Sinha et al. 1993]

Projection Ambiguity in Single Sketch



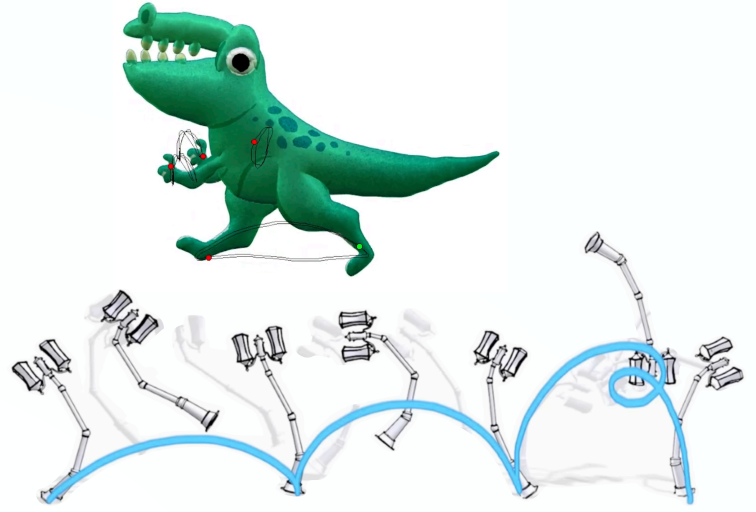
[Sinha et al. 1993]



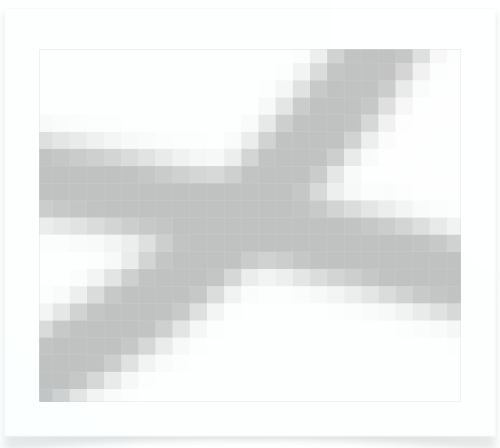
Tracking Samples



2D Sketches



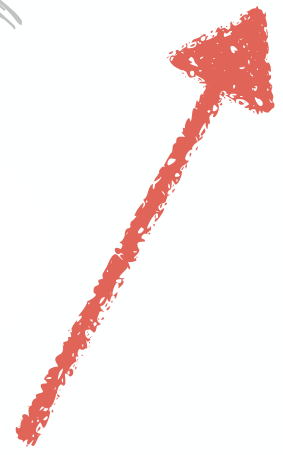
Models & Animations



Raster Samples



3D Sketches

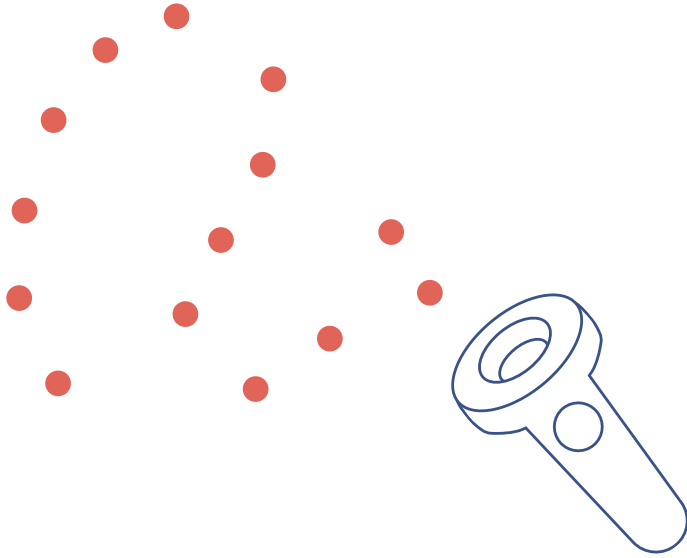


Sketch Surfacing



Creation Process

3D Sketches



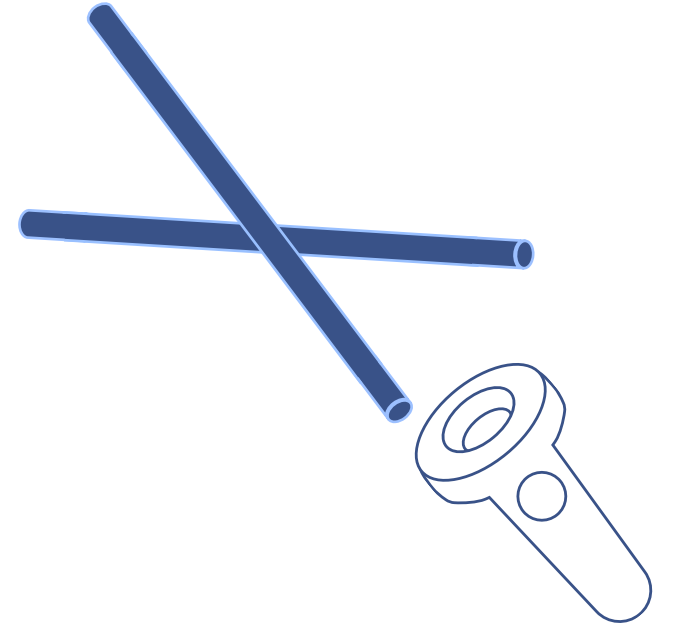
Samples

- No connectivity
- Inconsistently oriented normals



Ribbons

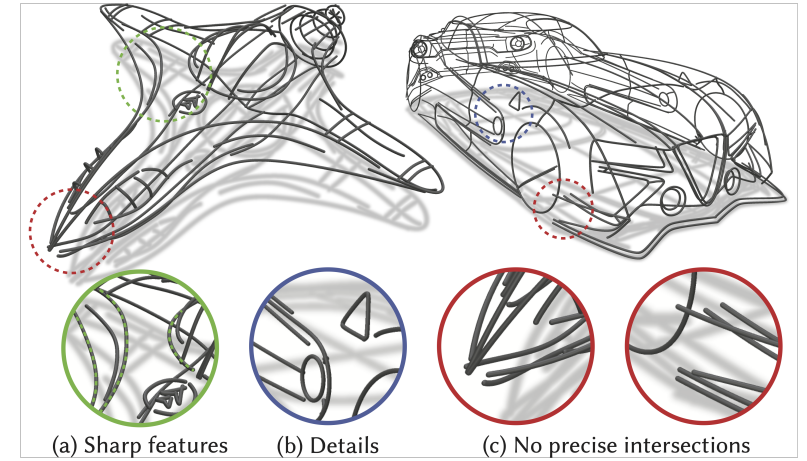
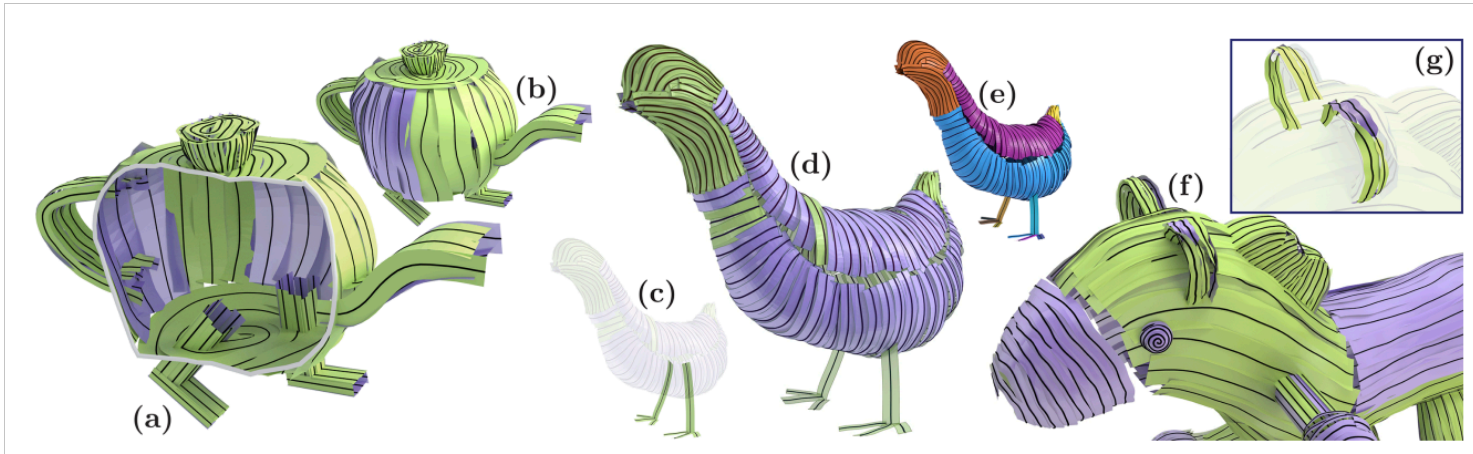
- With connectivity
- Inconsistently oriented normals
- Hidden parts



Tubes

- With connectivity
- No normals
- Can be lifted sketches

3D Sketches



Samples

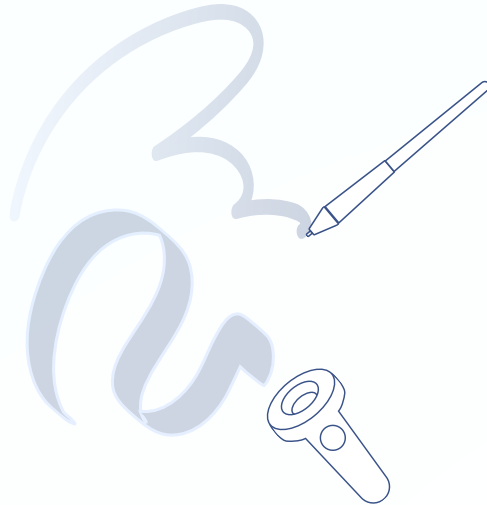
- No connectivity
- Inconsistently oriented normals

Ribbons

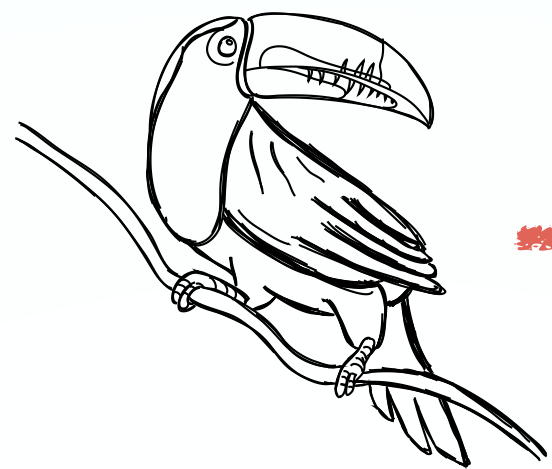
- With connectivity
- Inconsistently oriented normals
- Hidden parts

Tubes

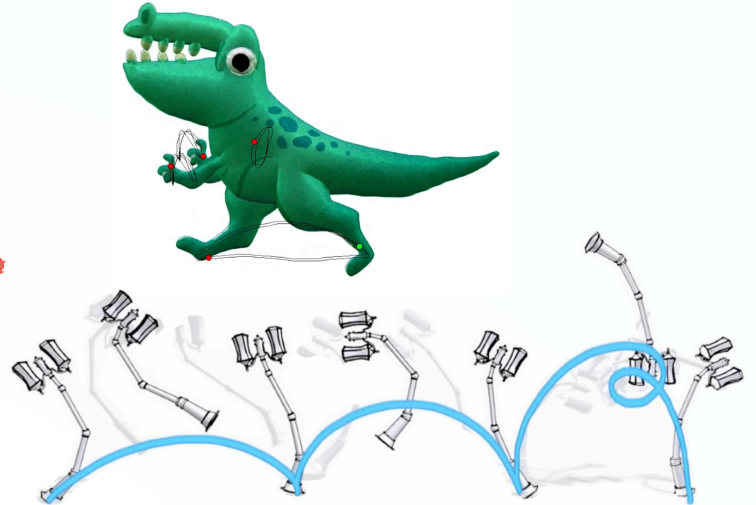
- With connectivity
- No normals
- Can be lifted sketches



Tracking Samples



2D Sketches



Models & Animations



Raster Samples



3D Sketches

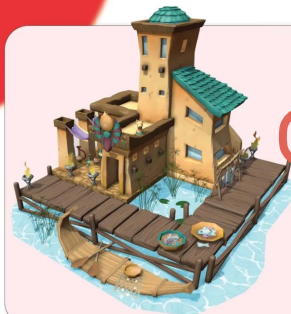
Sketch-Based Modeling & Animation



Creation Process

3D Modeling and Animation is Time-Consuming

time consumption of 3D crafting



Cartoony Building

- Modelling 10 Days
- Texture, UV map 4 Days
- Lighting, Shading 2 Days



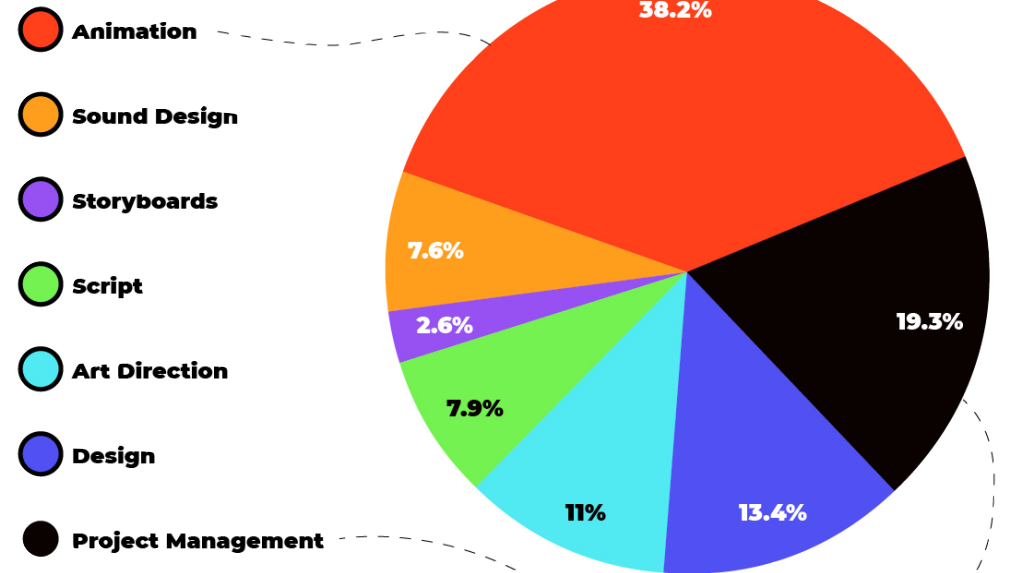
Stylized Character

- Modelling 10 Days
- Sculpting 6 Days
- Texture, UV map 3 Days
- Lighting, Shading 1 Day



Realistic Character

- Modelling 14 Days
- Sculpting 9 Days
- Texture, UV map 4 Days
- Lighting, Shading 2 Days



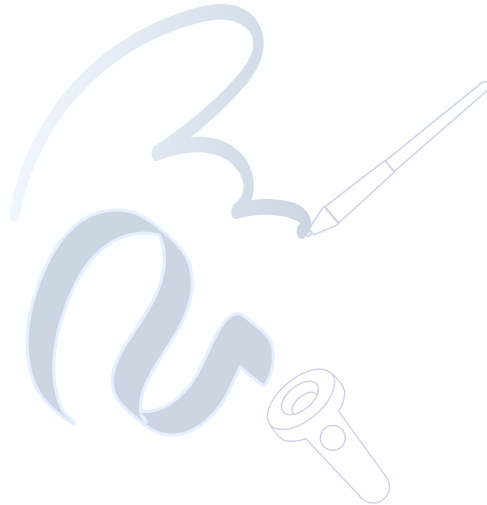
<https://madebythings.com/the-anatomy-of-an-animation-project/>

3D Modeling and Animation are Time-Consuming



Sketch-Based Approaches

- Intuitive and expressive
- Novice friendly
- Easy to communicate



Tracking Samples



2D Sketches



Sketch-Related Vision Tasks

Models & Animations



Raster Samples



3D Sketches

Data for Learning

Creation Process