

# Fundamentals and Applications of Sketch Processing

---

## Setups & Motivations

Misha & Chenxi

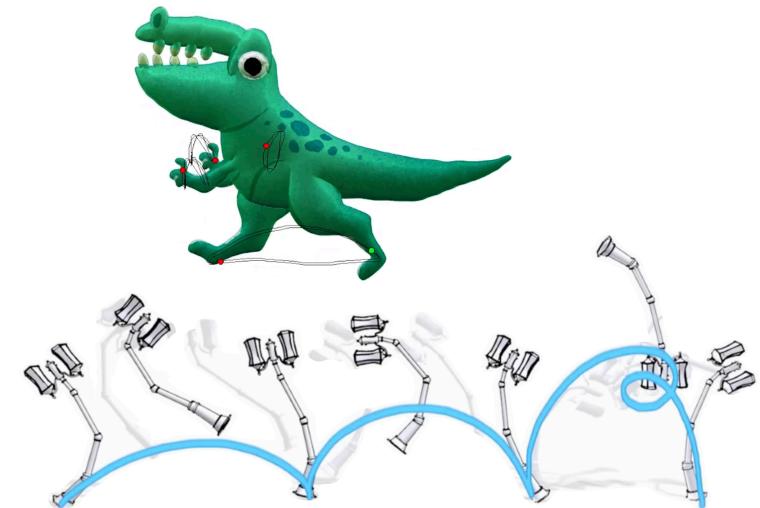




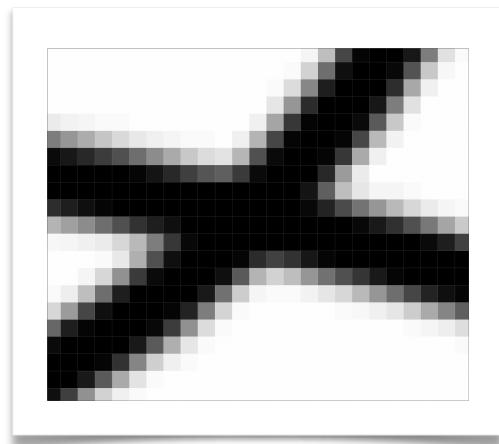
Tracking Samples



2D Sketches



Models & Animations



Raster Samples

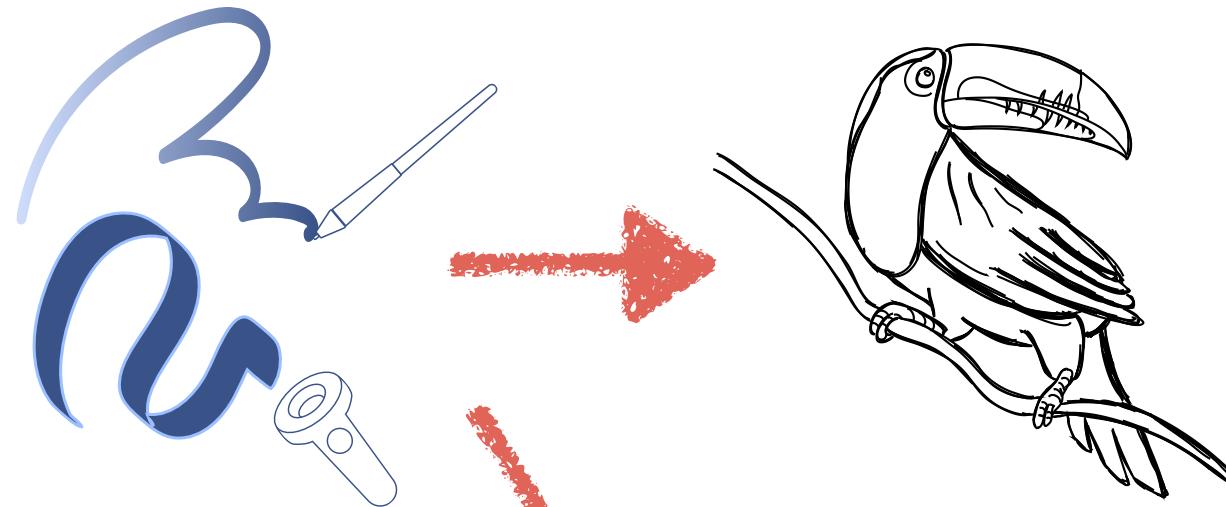


3D Sketches



Data for Learning

Creation Process



Tracking Samples

2D Sketches

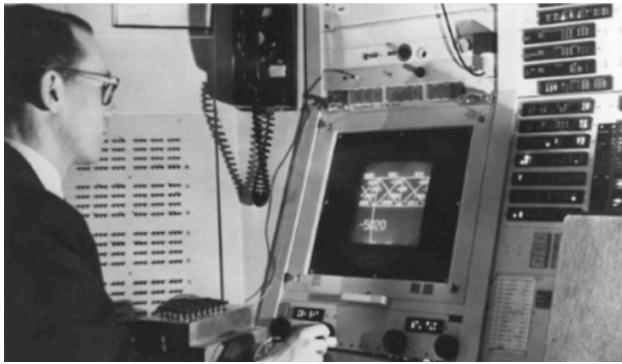


3D Sketches

**Stroke Construction & Drawing Interface**

**Creation Process**

# Digital Drawing Devices



Sutherland's Sketchpad  
(1963)



Pen and touch display  
(photo taken in 2019)

© David Revoy under CC BY 4.0  
<https://www.davidrevoy.com/>

## 2D Drawing Tablets



Various drawing tablets  
(photo taken in 2012)

© David Revoy under CC BY 4.0  
<https://www.davidrevoy.com/>

## 2D Drawing Tablets



HTC Vive Pro 2  
(2021)

## 3D Drawing Systems



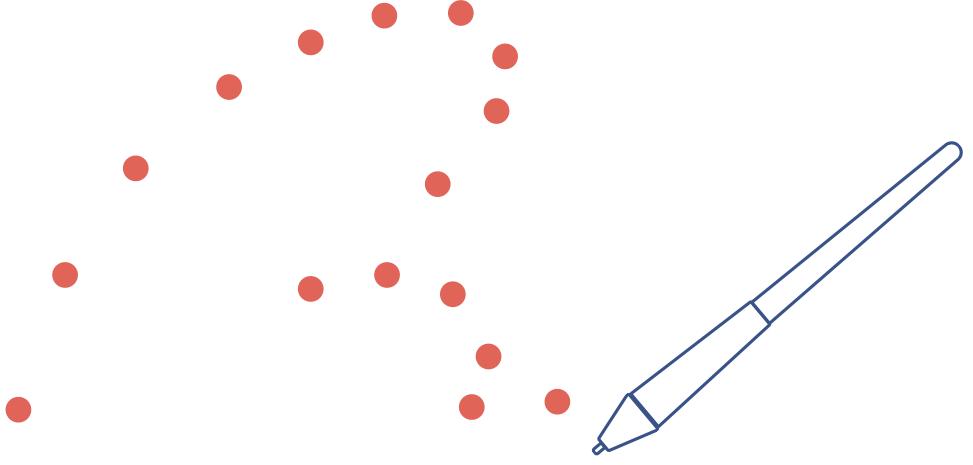
Sutherland's HMD  
(1968)



Apple Vision Pro  
(2024)

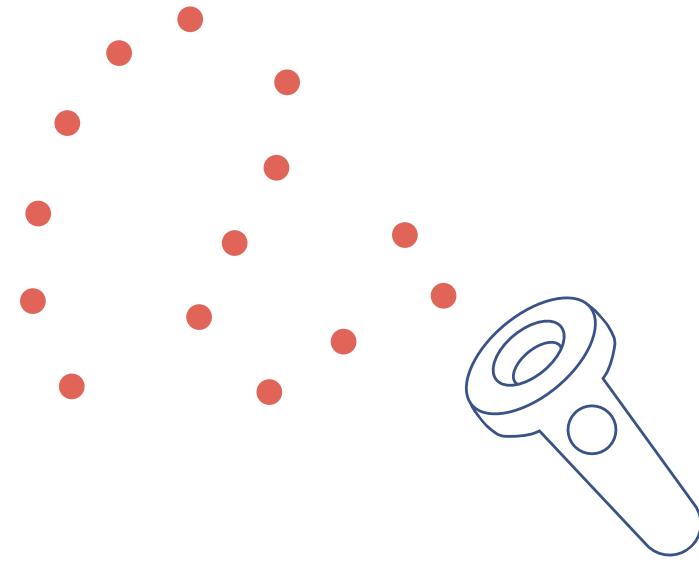
# Tracking Samples

---



**2D sample sequence**

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

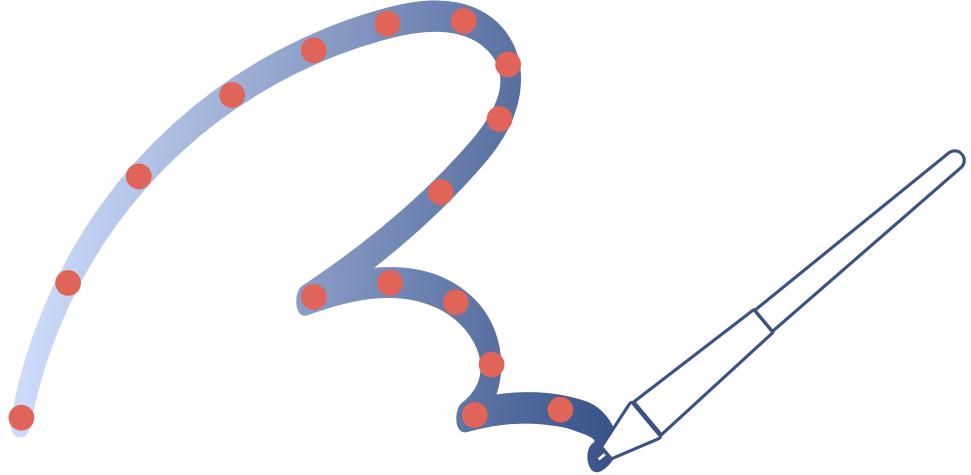


**3D sample sequence**

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

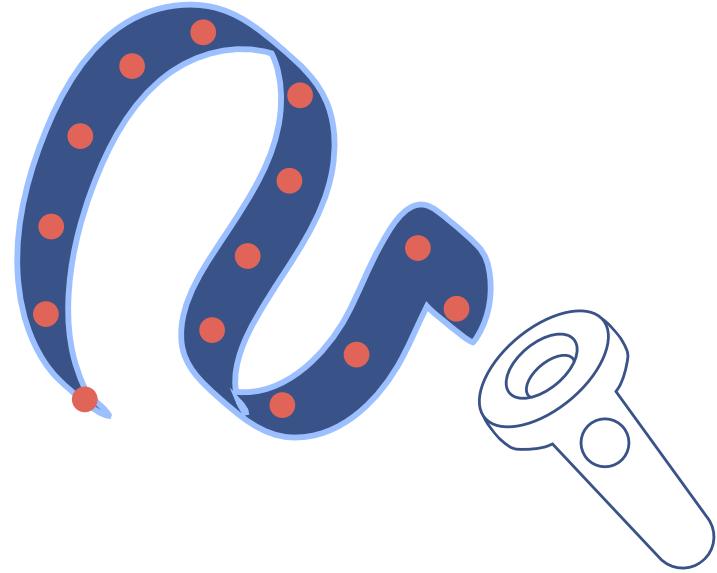
# Stroke Representations

---



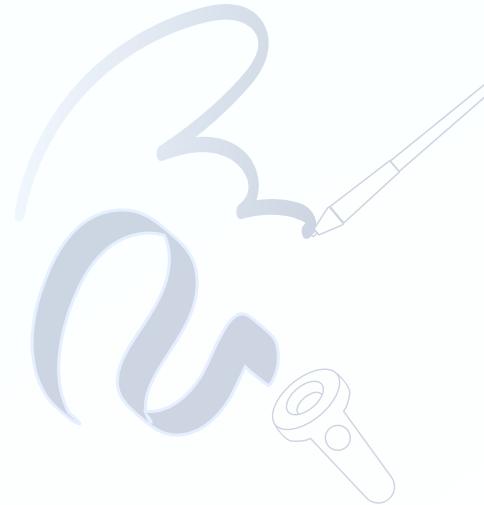
## 2D stroke representations

- Polylines
- Parametric curves
- Splines
- etc.

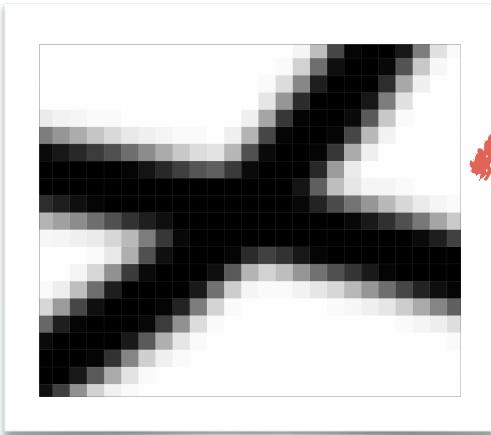


## 3D stroke representations

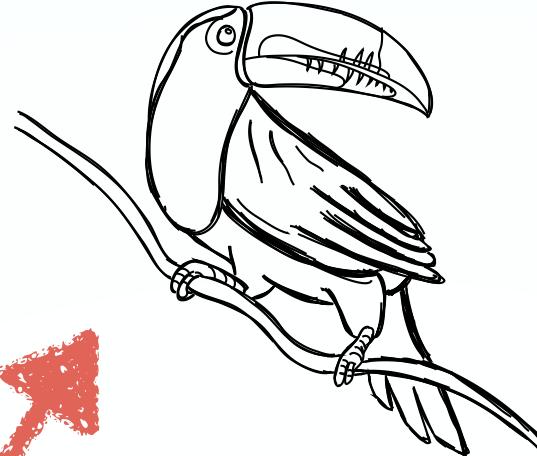
- Tubes
- Calligraphic curves  
(ribbons)
- etc.



Tracking Samples



Raster Samples



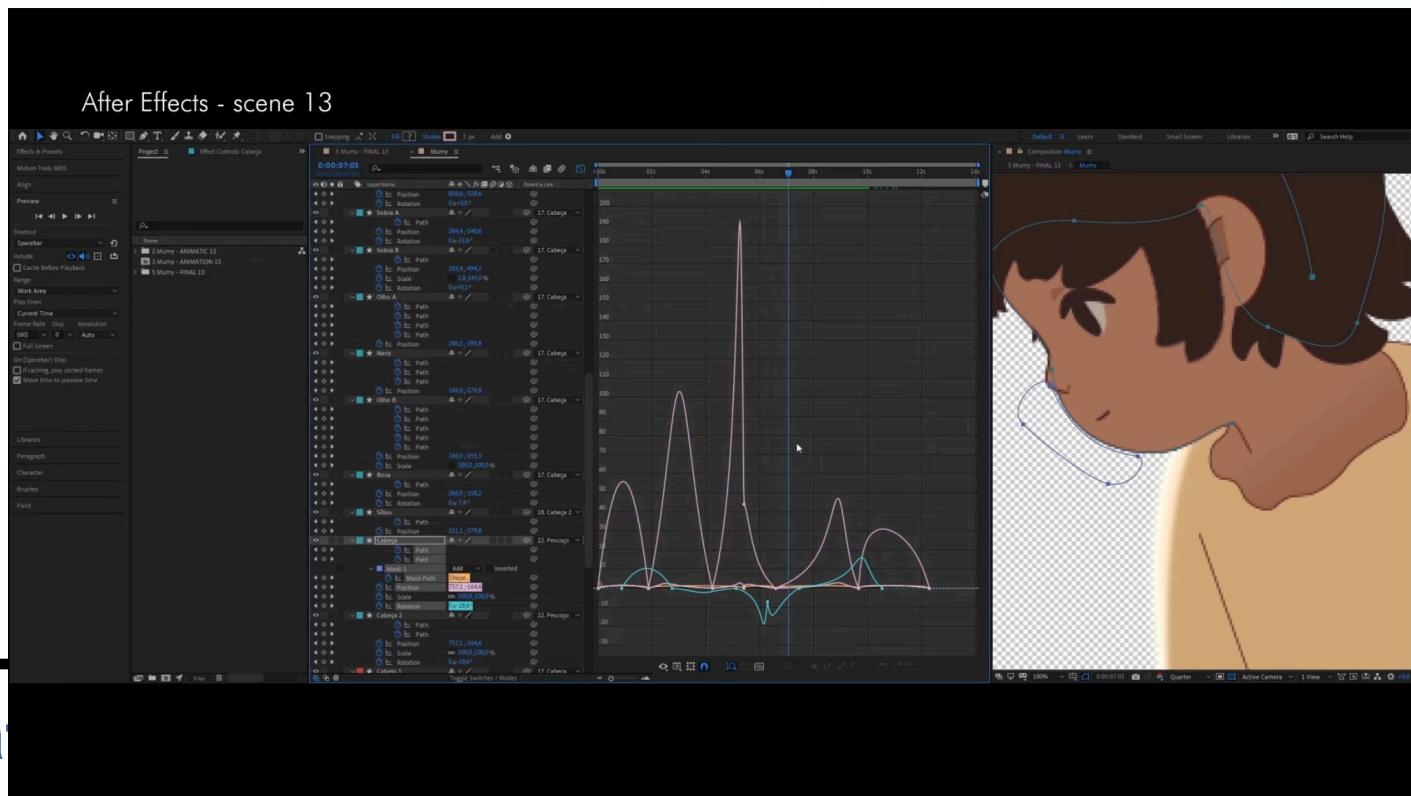
2D Sketches



Vectorization

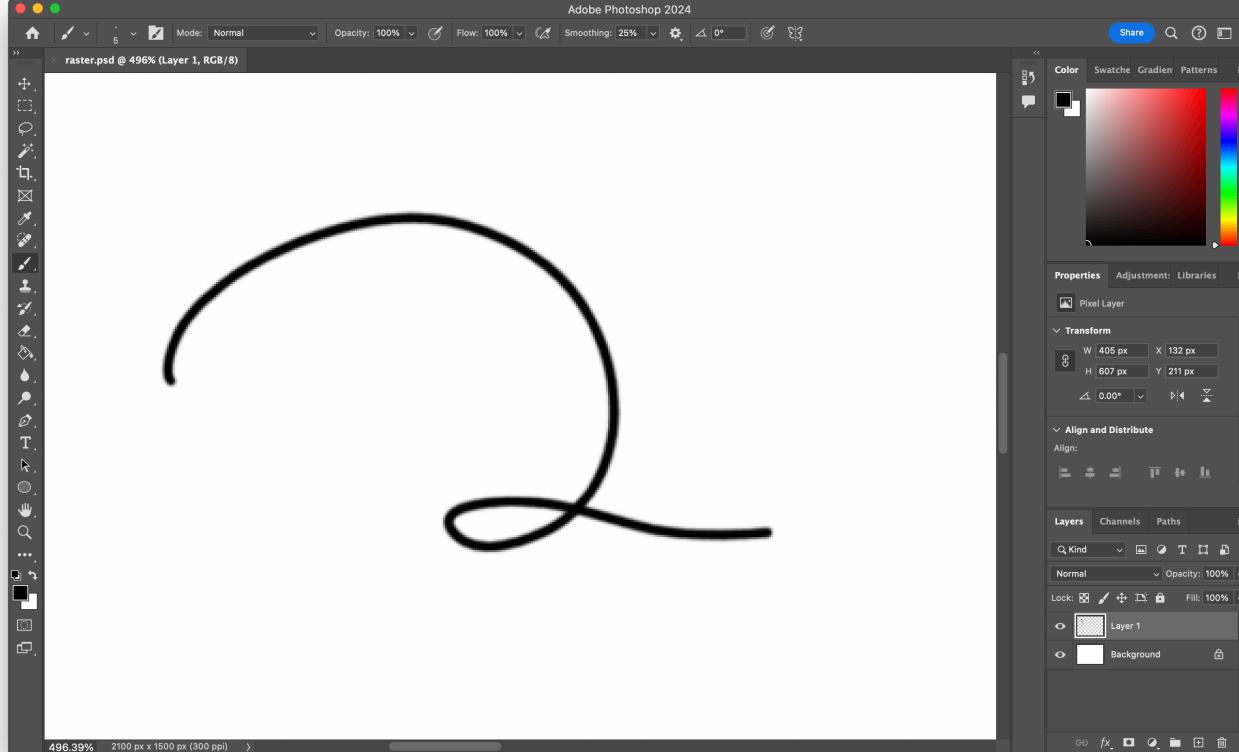
© Victor Ishihara

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

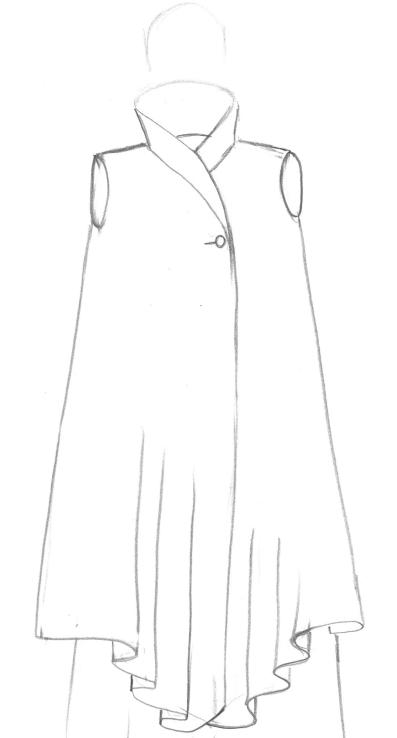


Create

# Non-Sequential 2D Samples: Pixels



Digital drawings



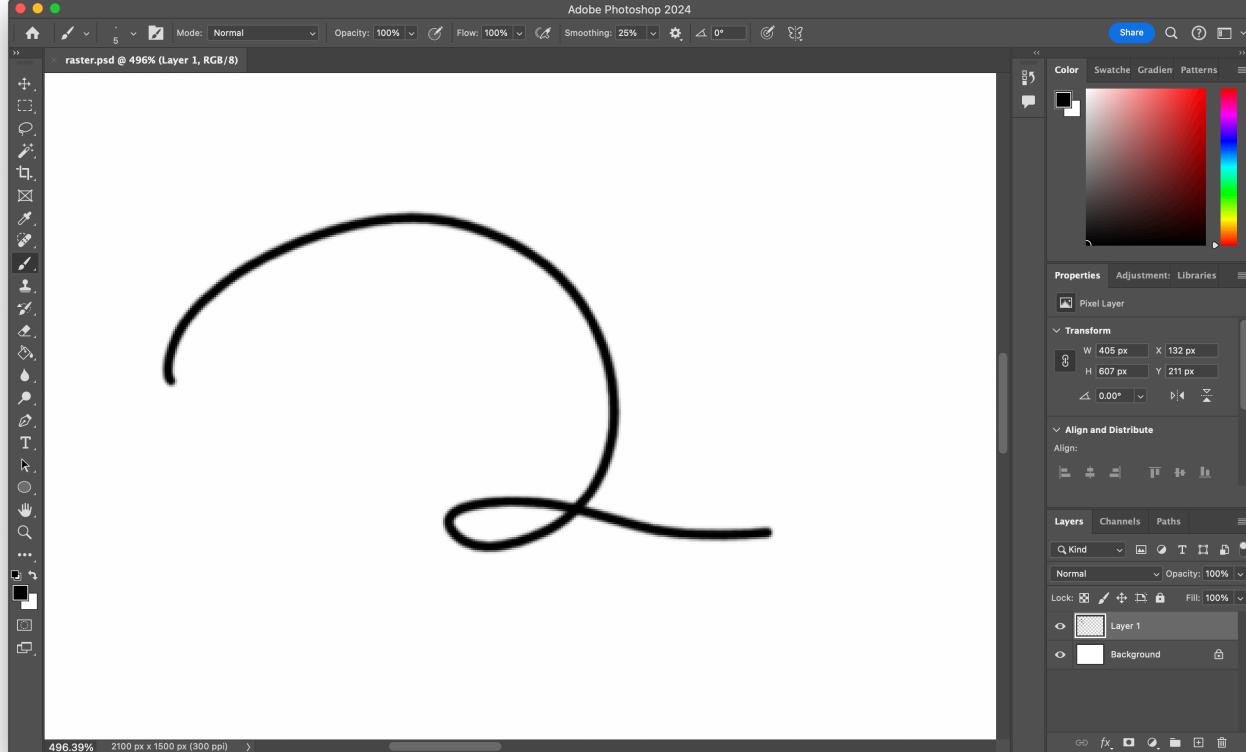
© Myriam Lasserre, CC-BY-SA-4.0



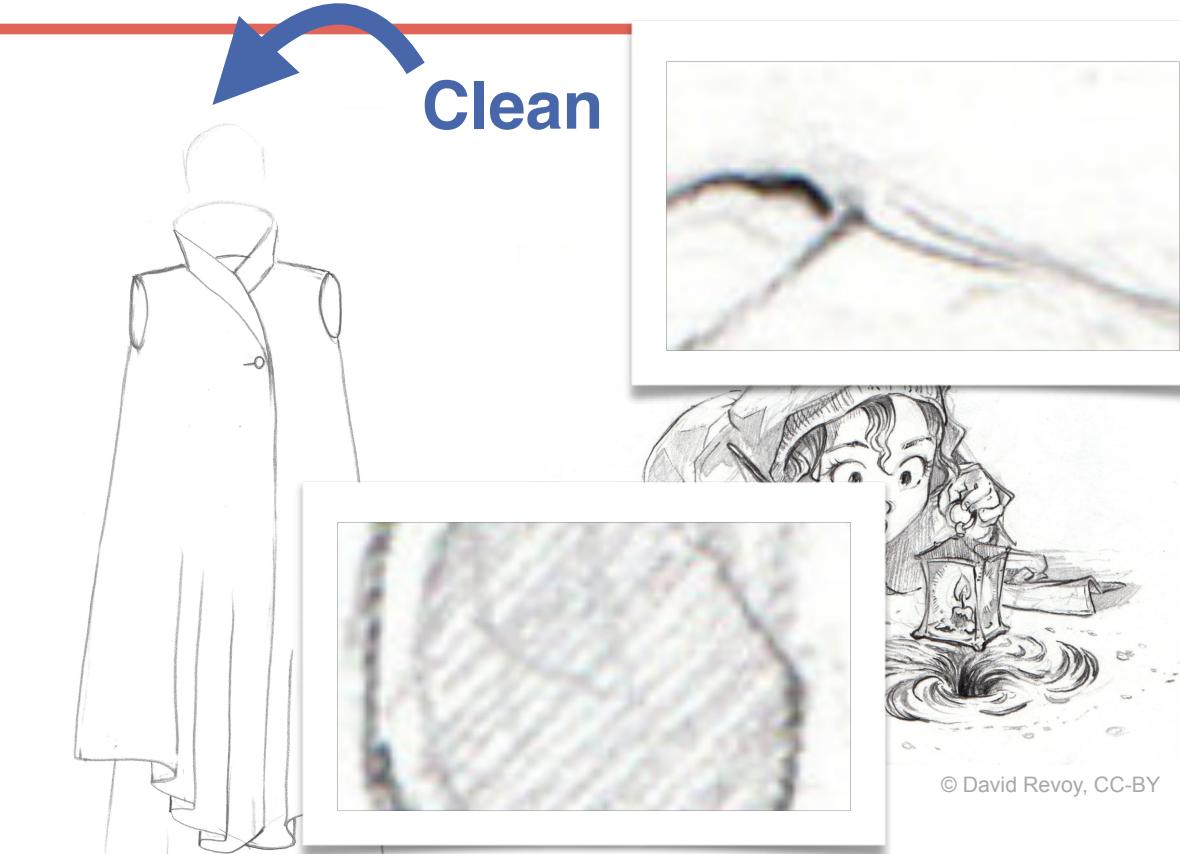
© David Revoy, CC-BY

Digital scans

# Non-Sequential 2D Samples: Pixels



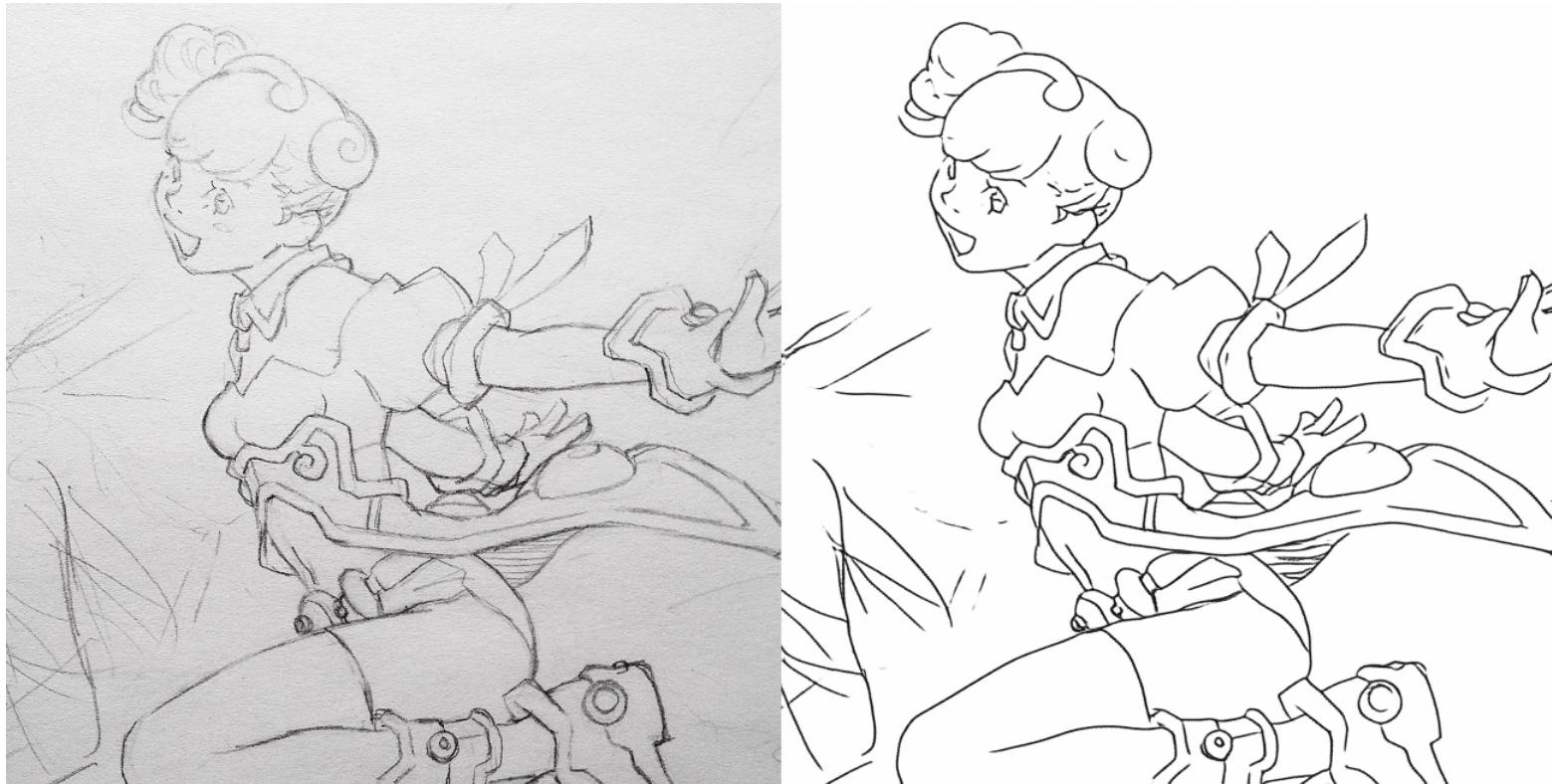
Digital drawings



Digital scans

# Raster Sketch Cleanup

---



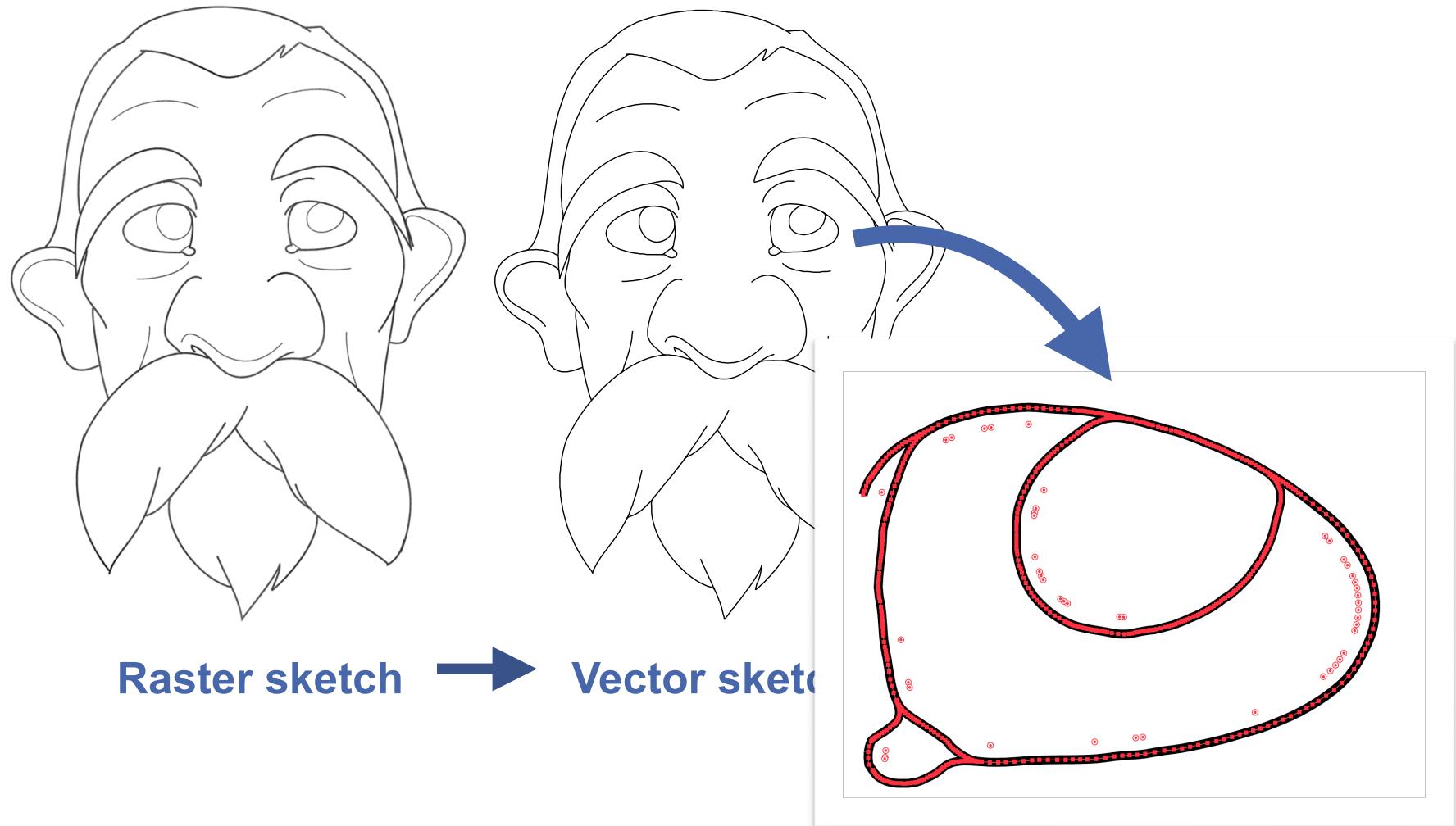
Raster rough  
sketch

Raster clean  
sketch

Good for preprocessing

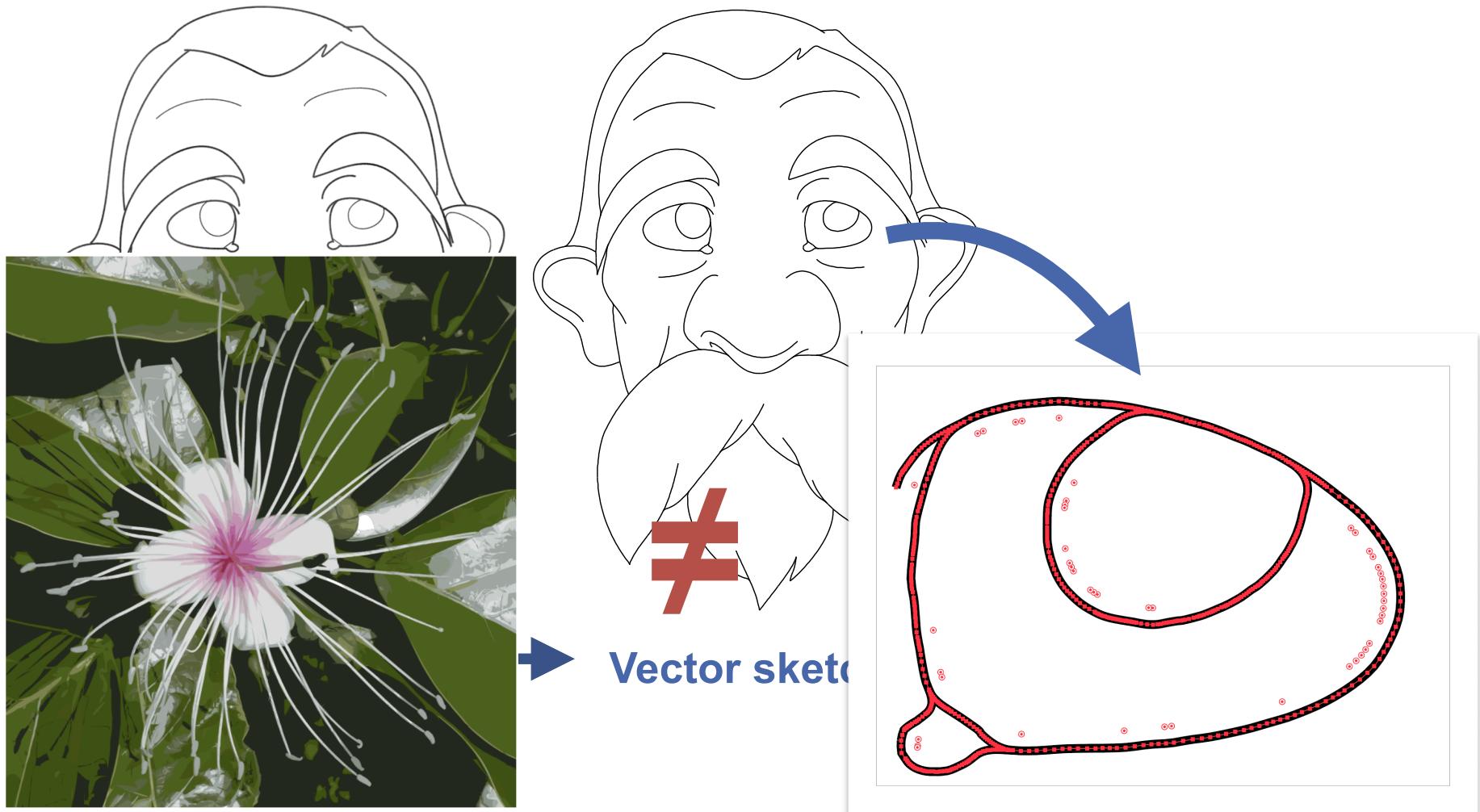
# Sketch Vectorization

---



# Sketch Vectorization

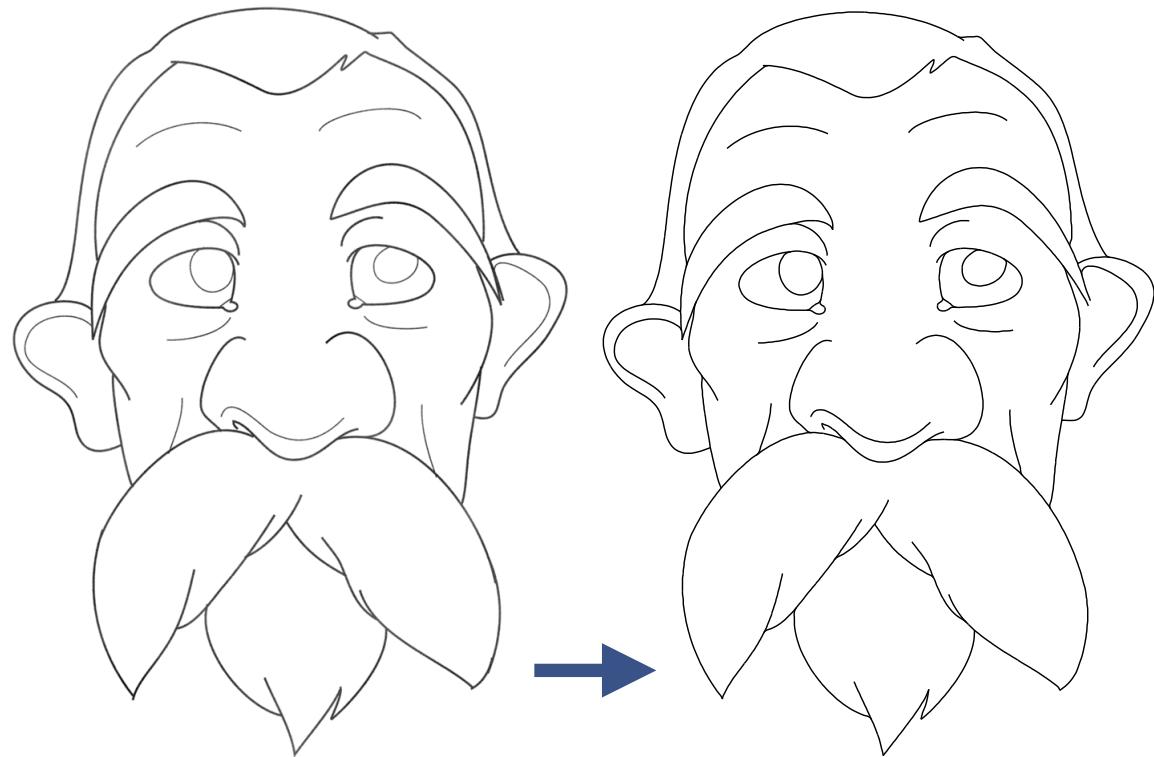
---



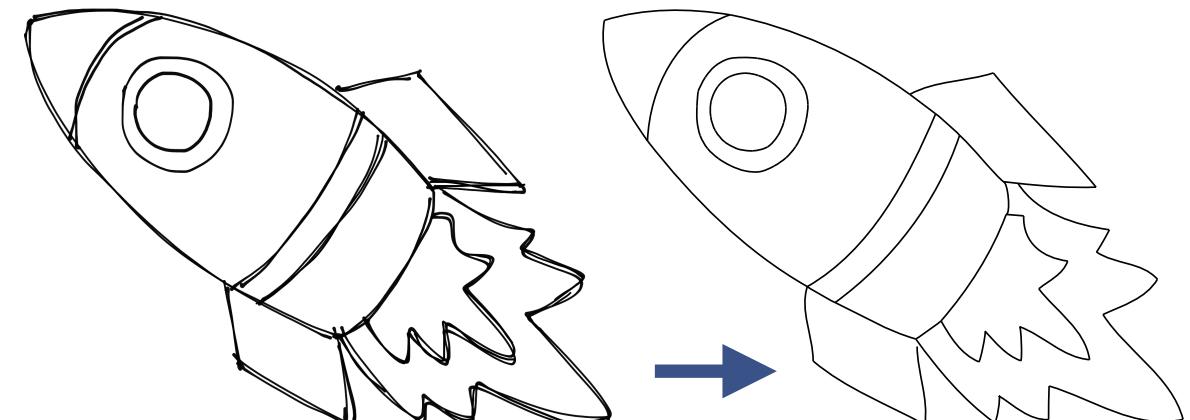
[Li et al. 2020], DiffSVG

# Sketch Vectorization

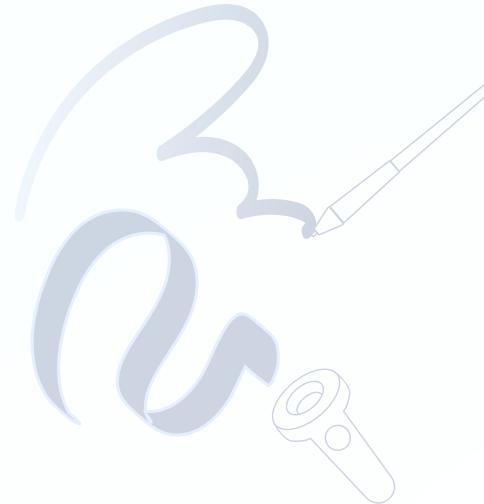
---



Clean sketch



Overdrawn sketch



Tracking Samples



2D Sketches



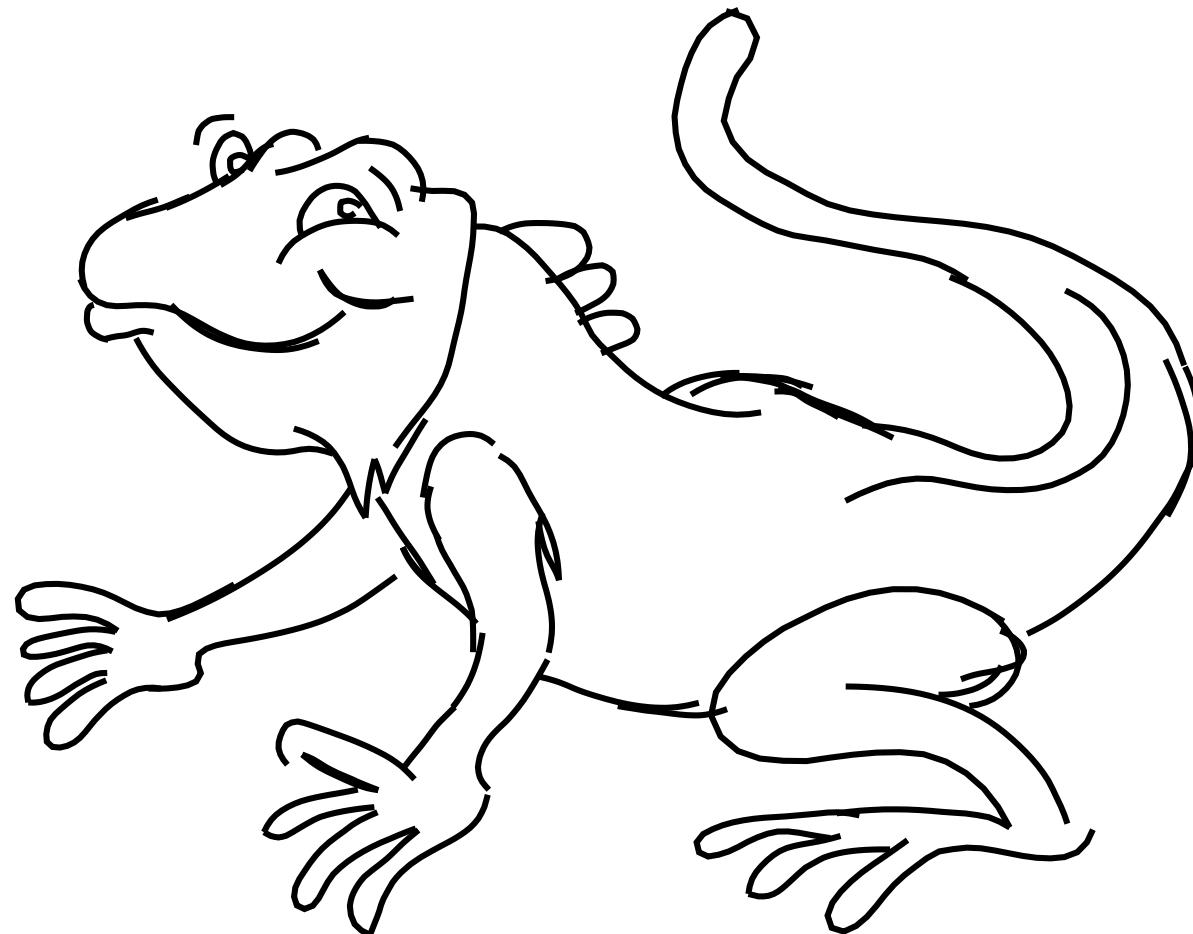
Raster Samples

**Sketch Cleanup &  
Flat Colorization**

**Creation Process**

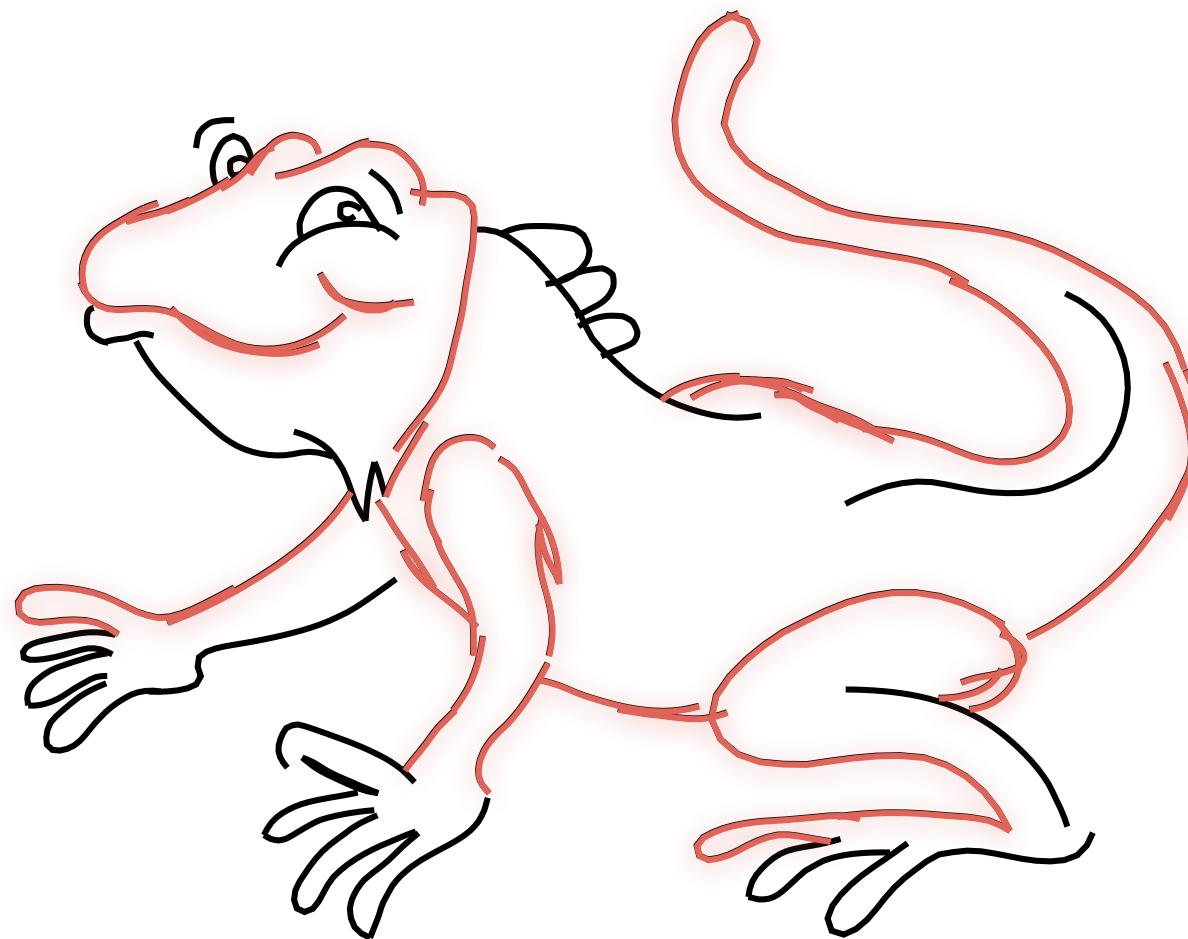
# Typical Sketches

---

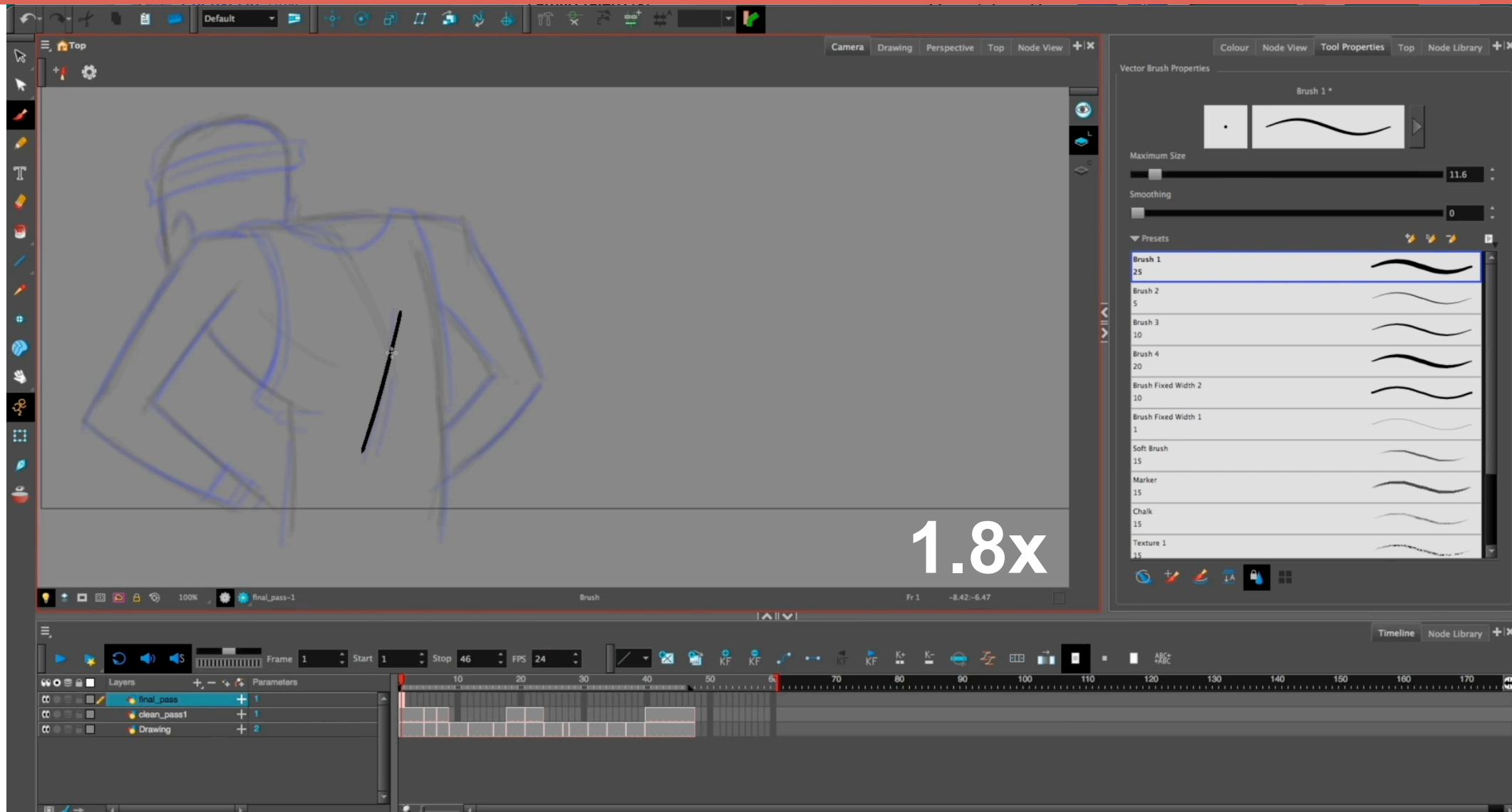


# Typical Sketches

---

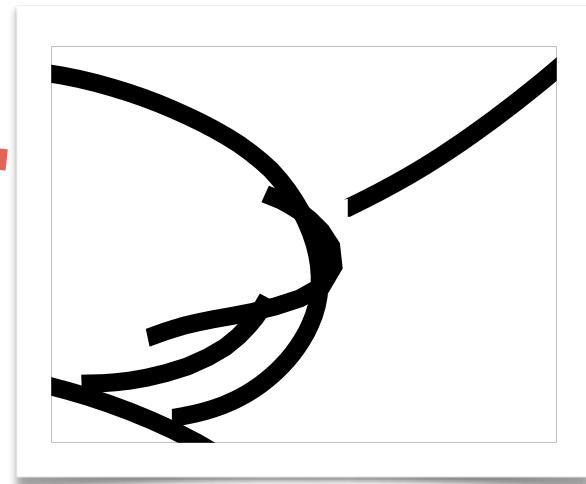
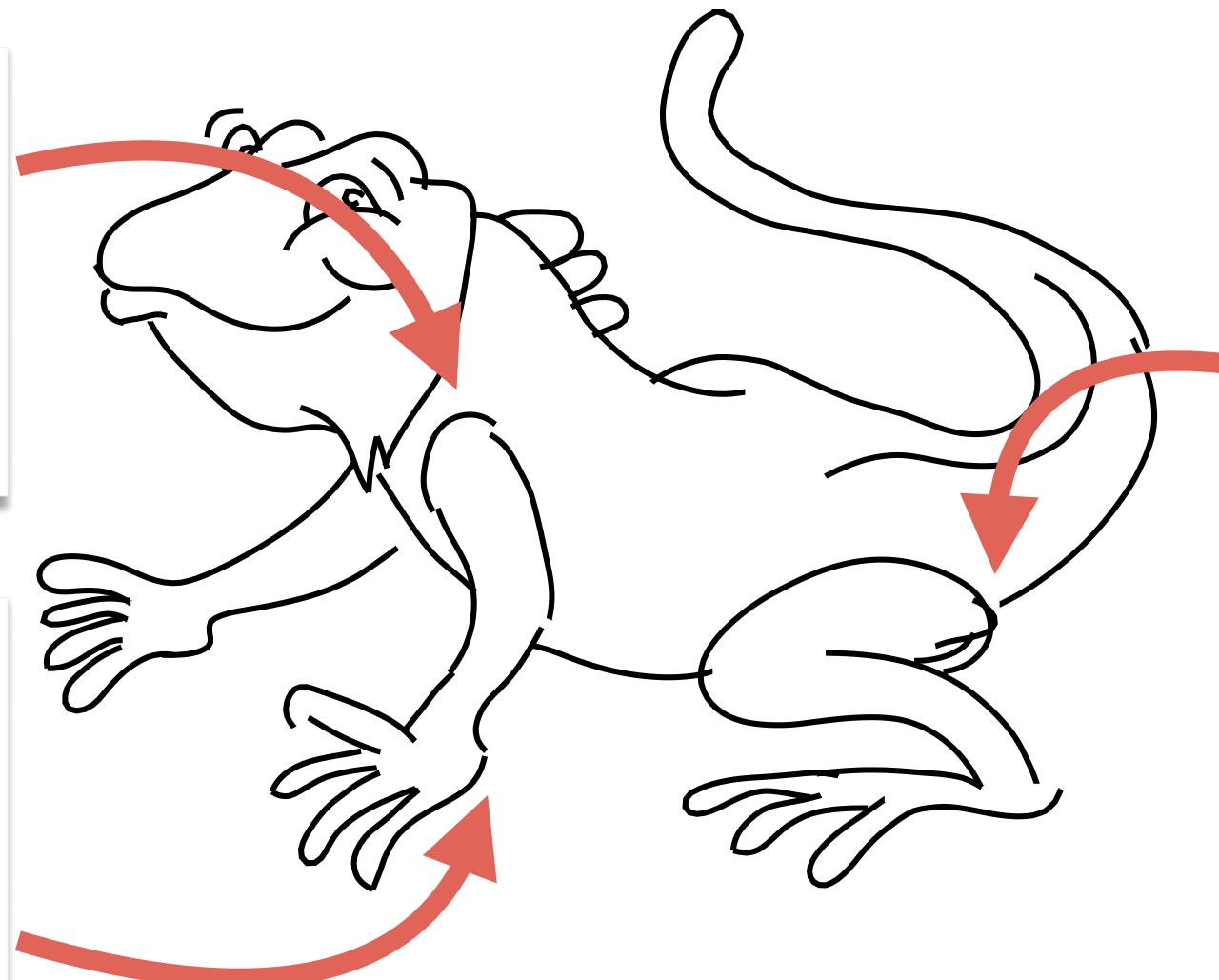
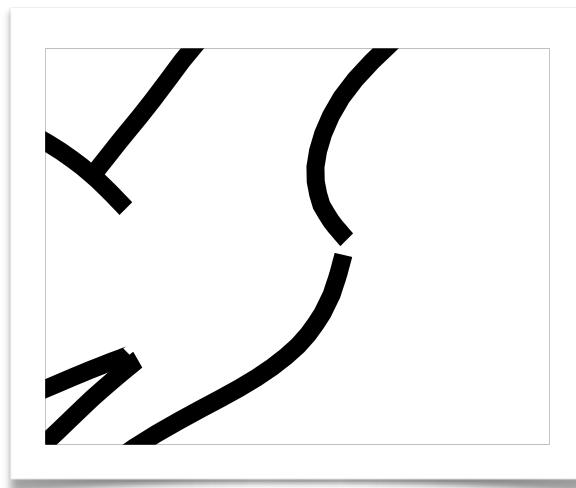
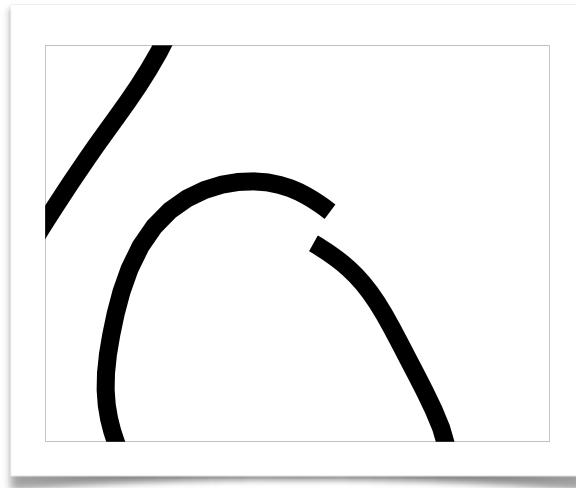


# Sketch Topology: Cleanup/Simplification/Consolidation

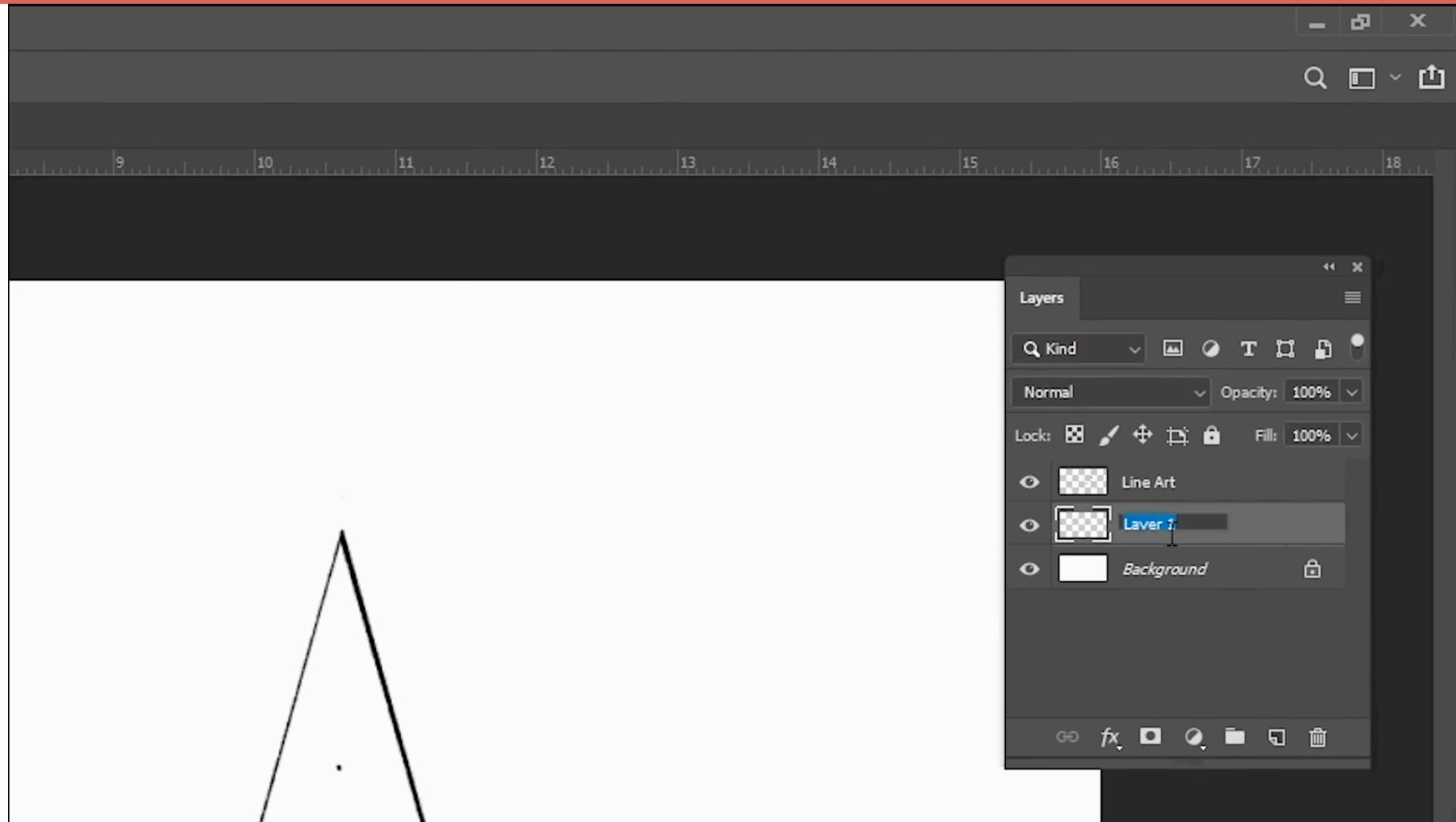


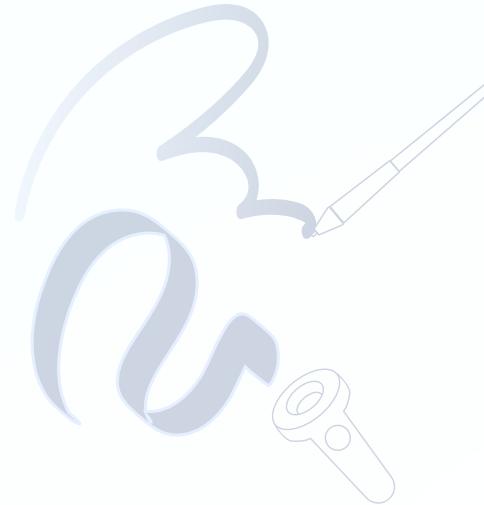
# Typical Sketches

---

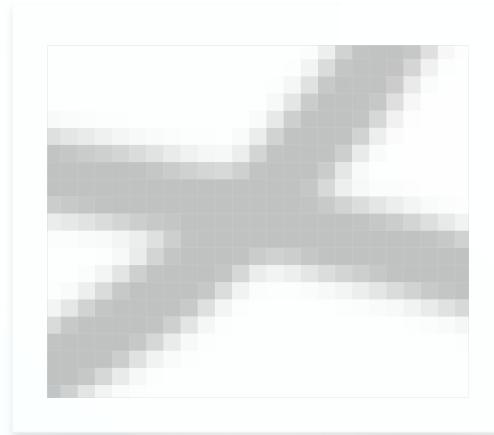


# Sketch Topology: Flat Colorization/Junction Reconstruction

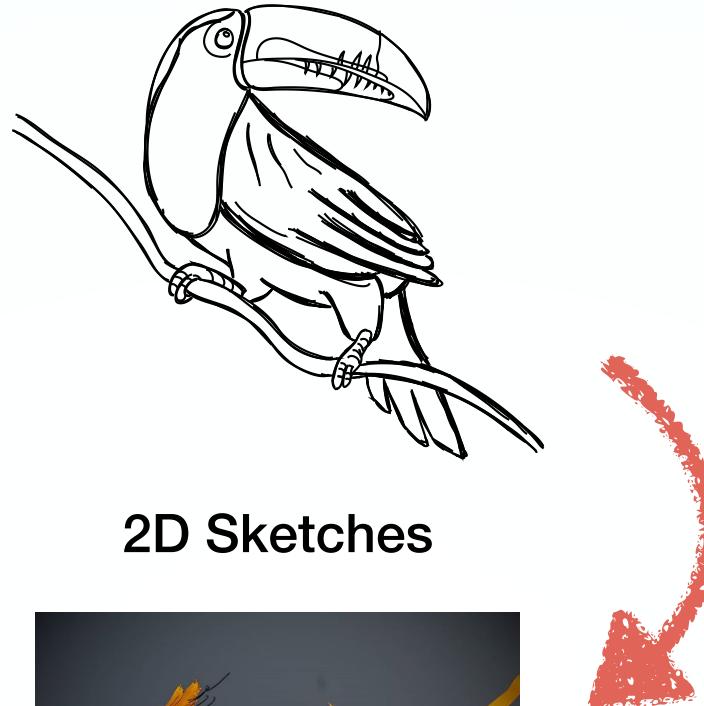




Tracking Samples



Raster Samples

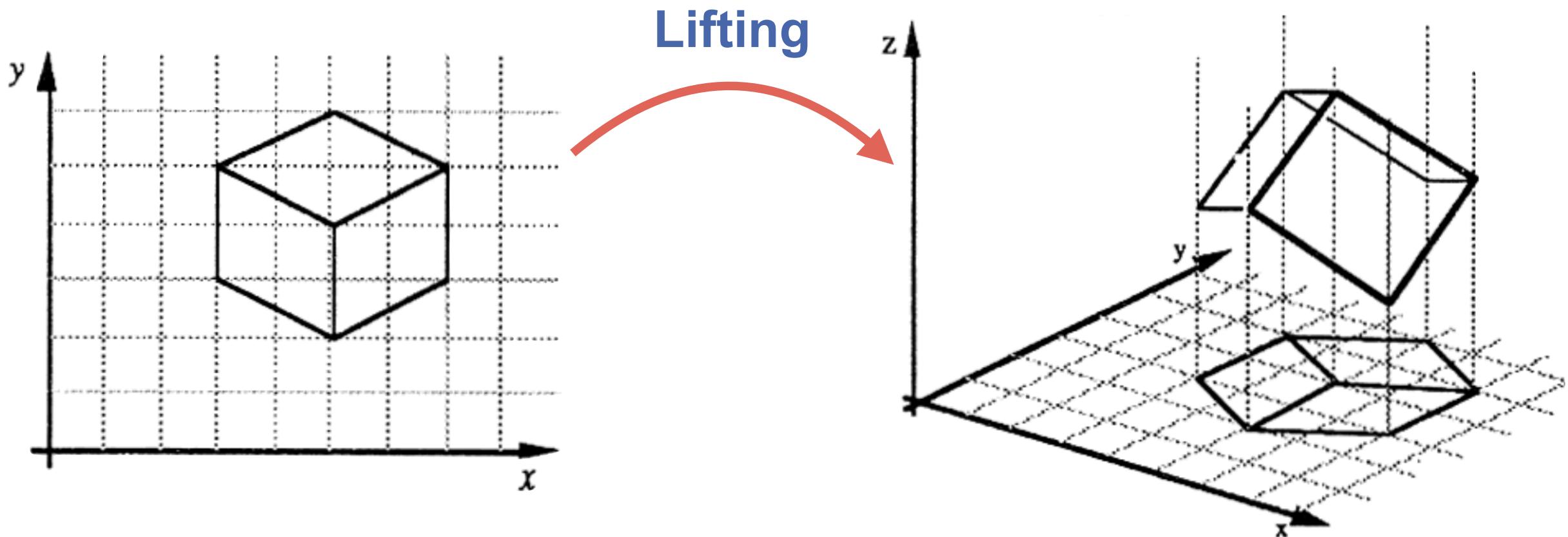


3D Sketches

**Sketch Lifting**

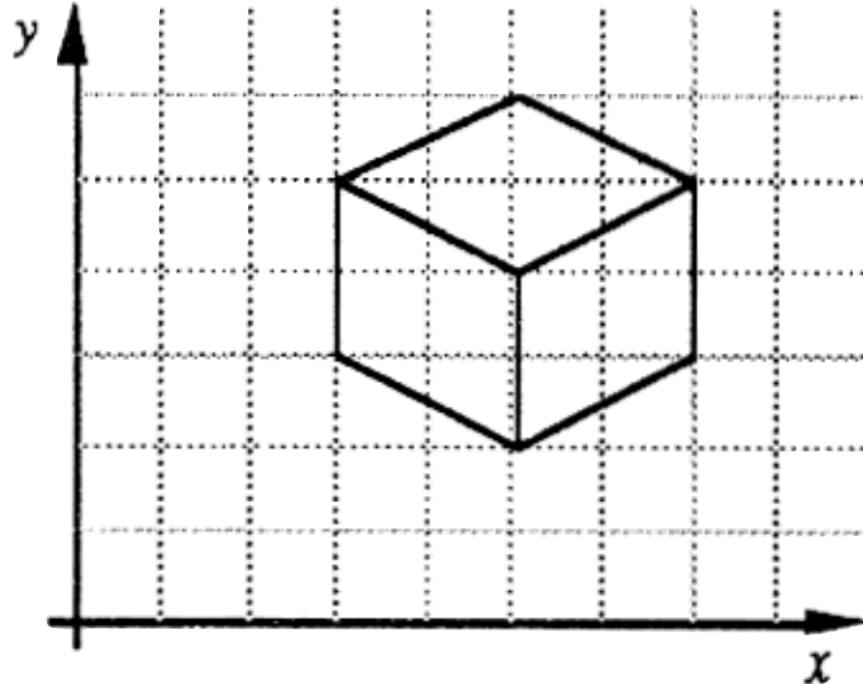
**Creation Process**

# Projection Ambiguity in Single Sketch

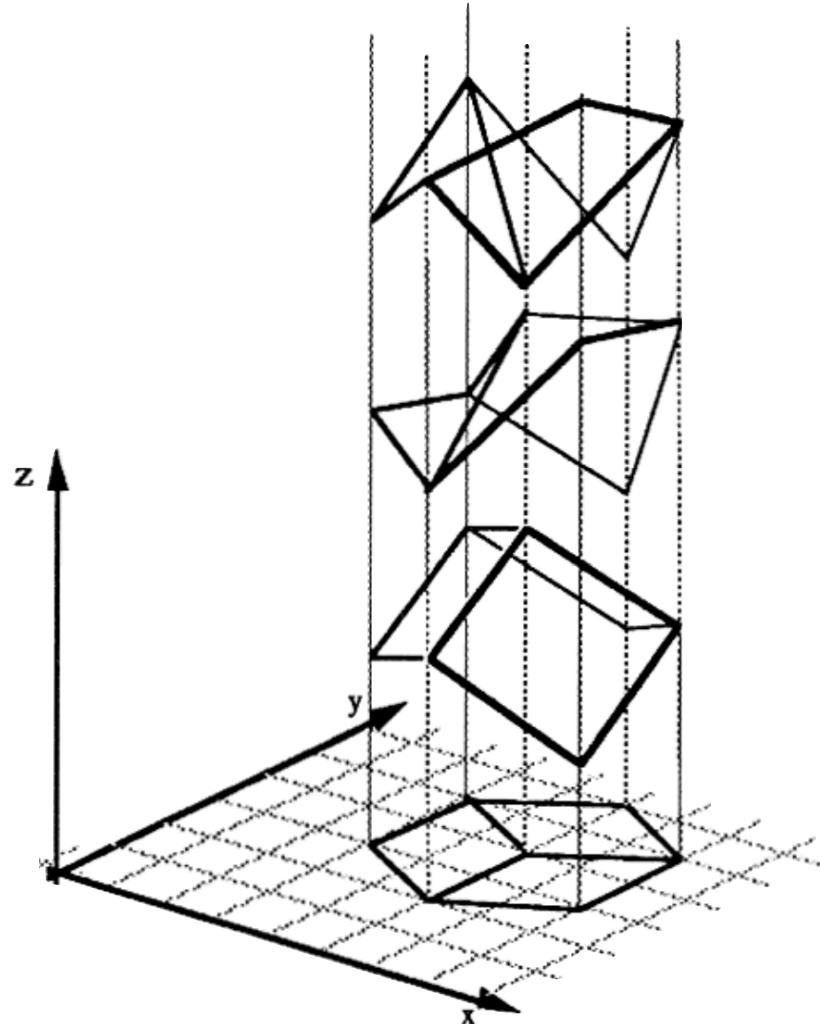


[Sinha et al. 1993]

# Projection Ambiguity in Single Sketch

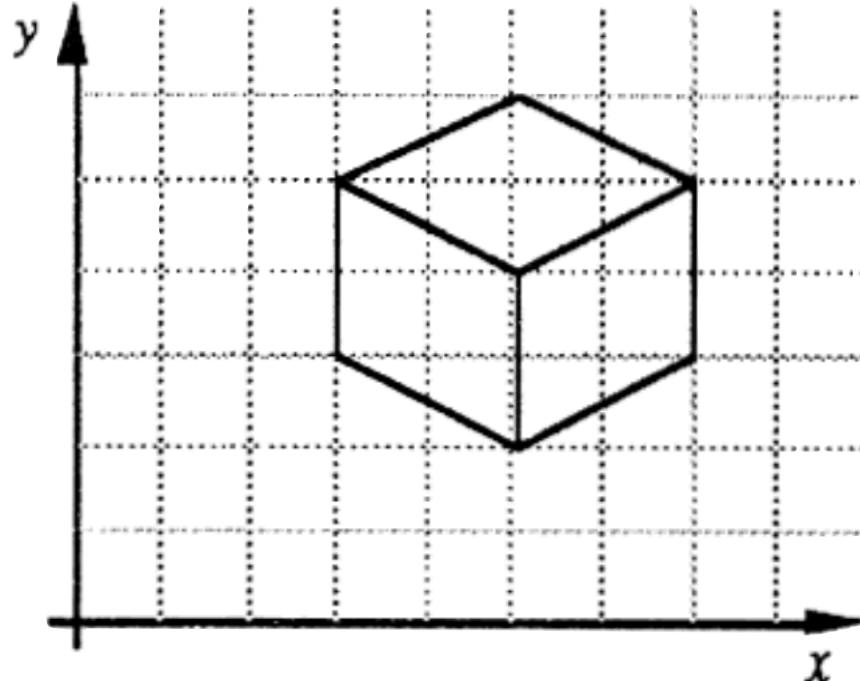


Lifting



[Sinha et al. 1993]

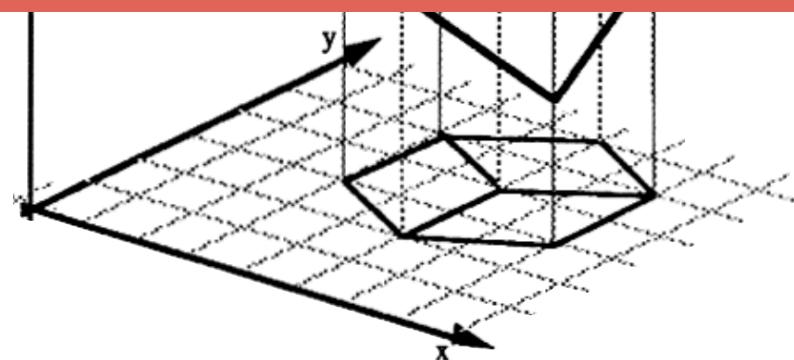
# Projection Ambiguity in Single Sketch



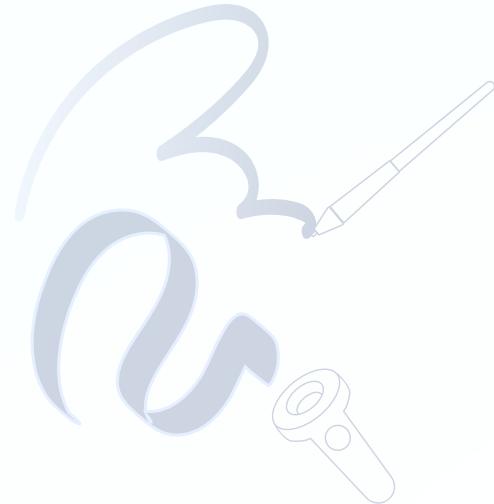
Lifting



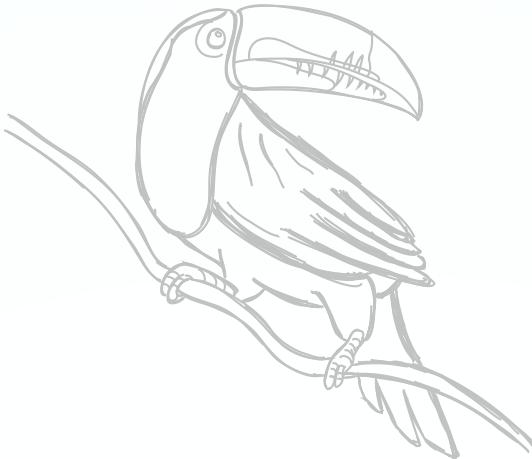
ill-conditioned



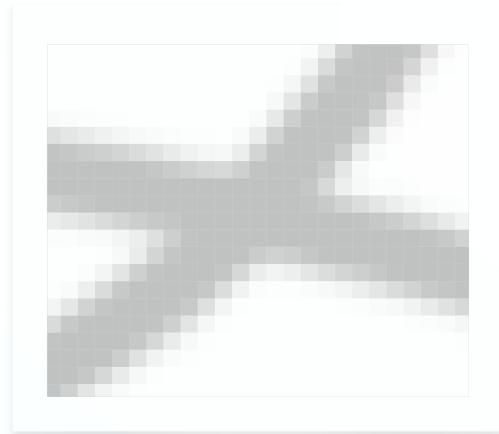
[Sinha et al. 1993]



Tracking Samples



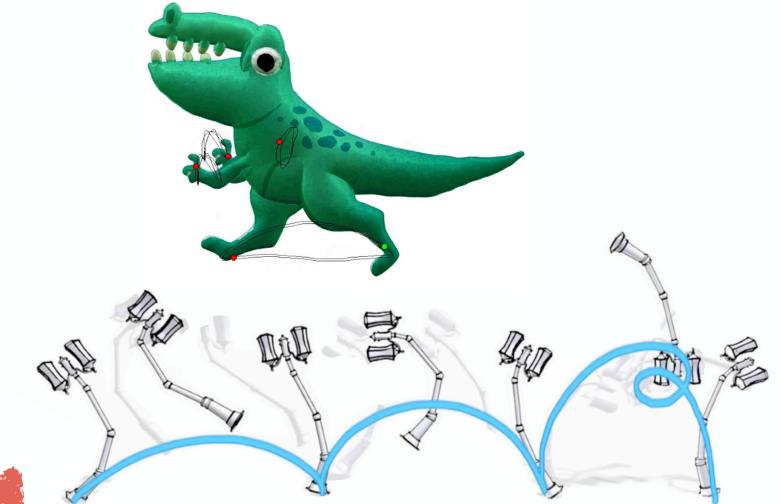
2D Sketches



Raster Samples



3D Sketches



Models & Animations

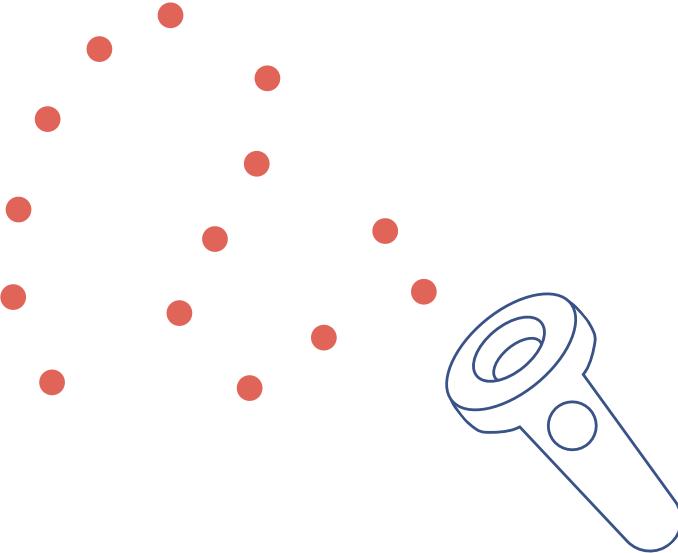


**Sketch Surfacing**

**Creation Process**

# 3D Sketches

---



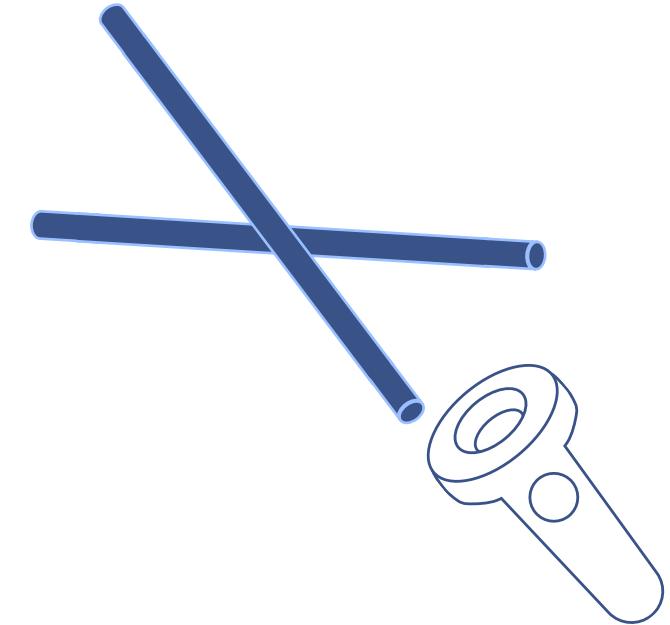
## Samples

- No connectivity
- Inconsistently oriented normals



## Ribbons

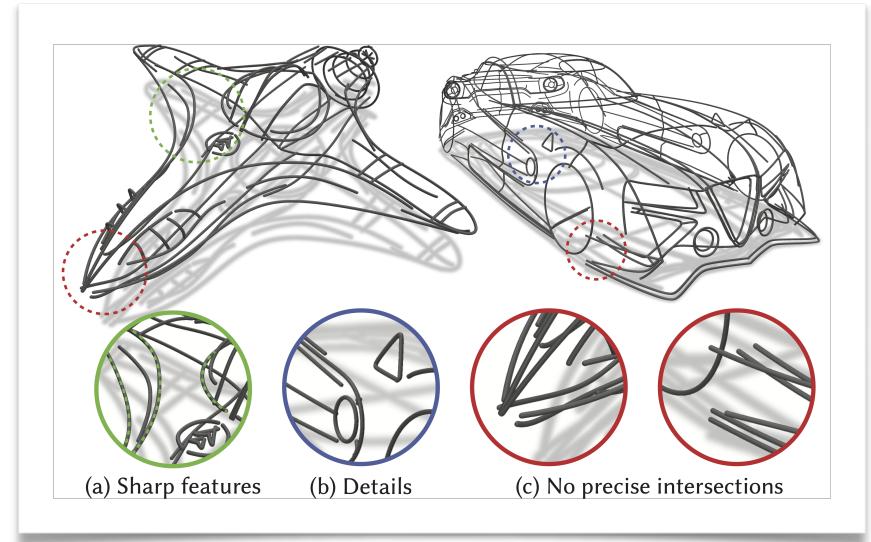
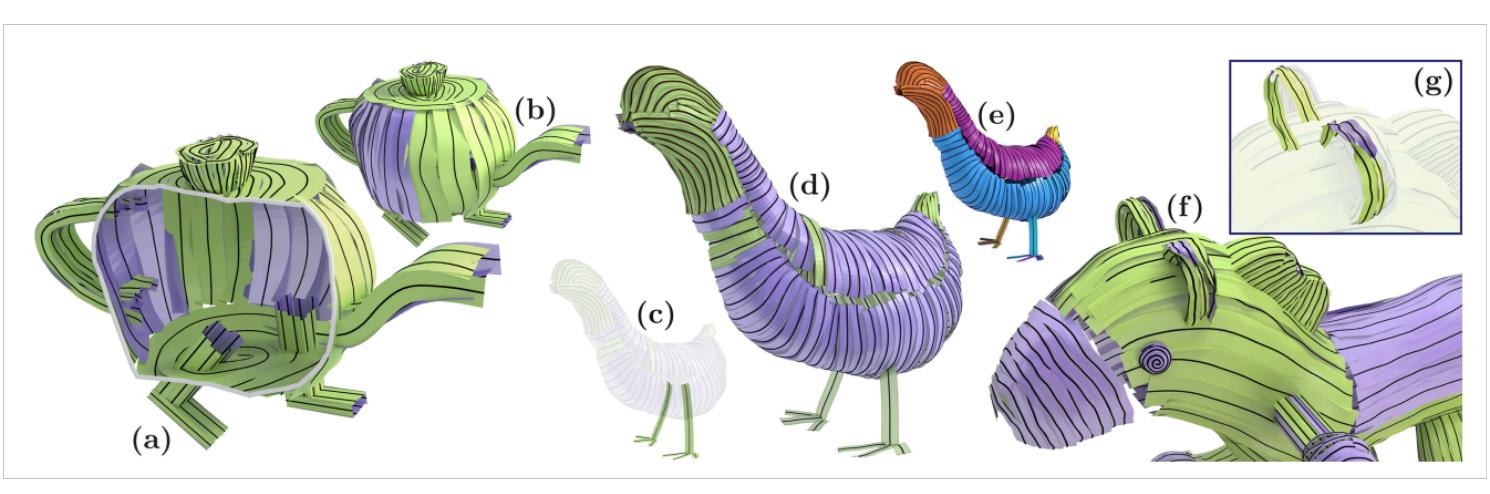
- With connectivity
- Inconsistently oriented normals
- Hidden parts



## Tubes

- With connectivity
- No normals
- Can be lifted sketches

# 3D Sketches



## Samples

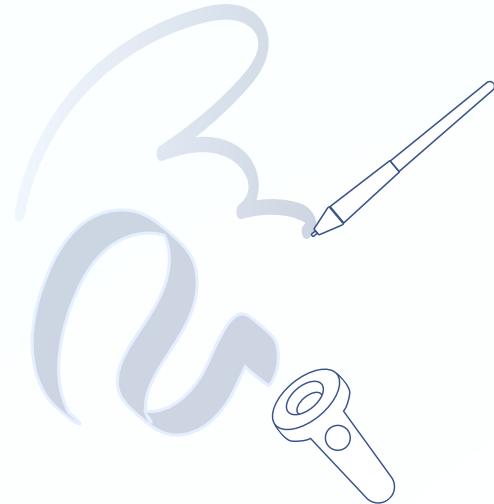
- No connectivity
- Inconsistently oriented normals

## Ribbons

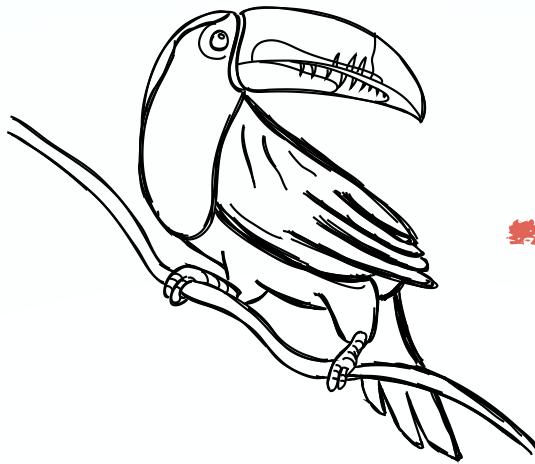
- With connectivity
- Inconsistently oriented normals
- Hidden parts

## Tubes

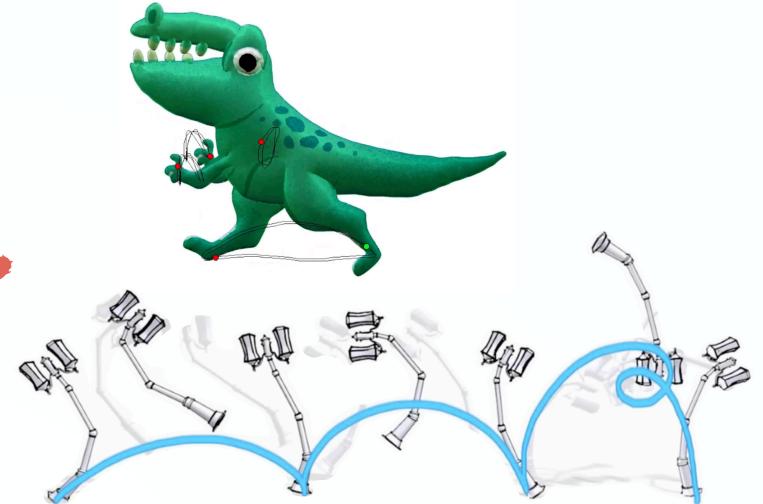
- With connectivity
- No normals
- Can be lifted sketches



Tracking Samples



2D Sketches



Models & Animations



Raster Samples

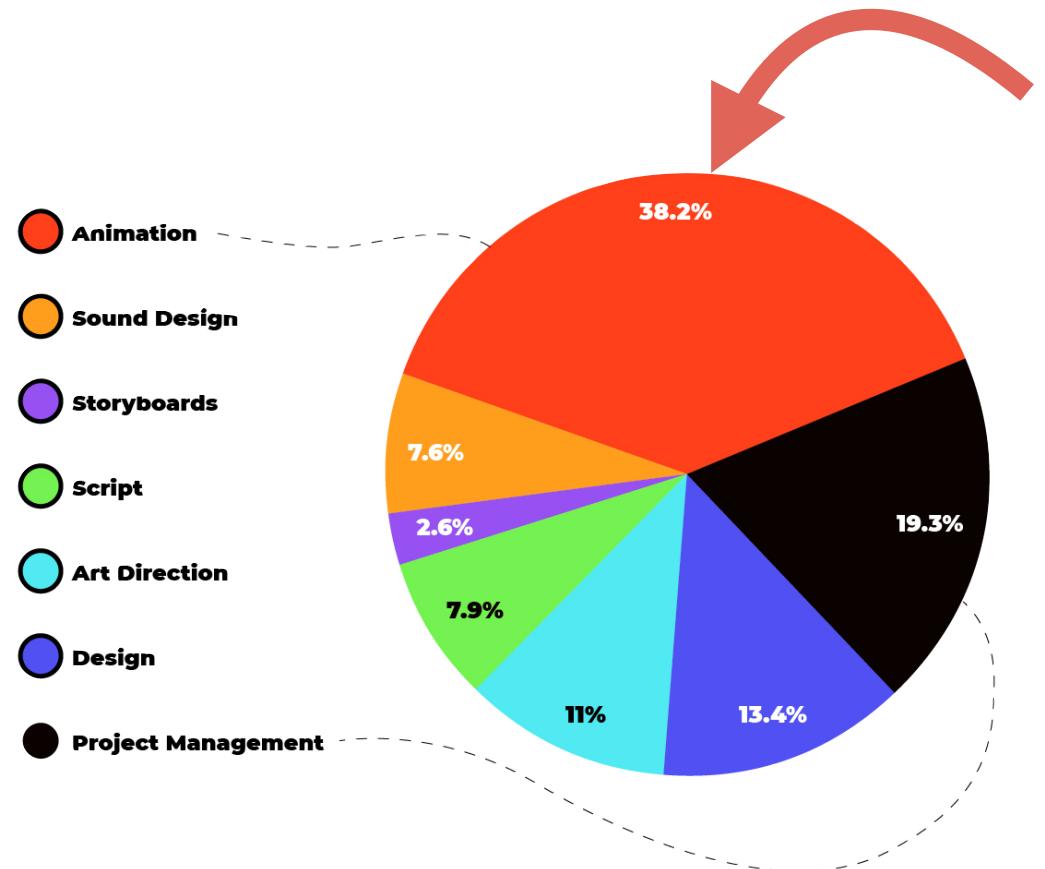
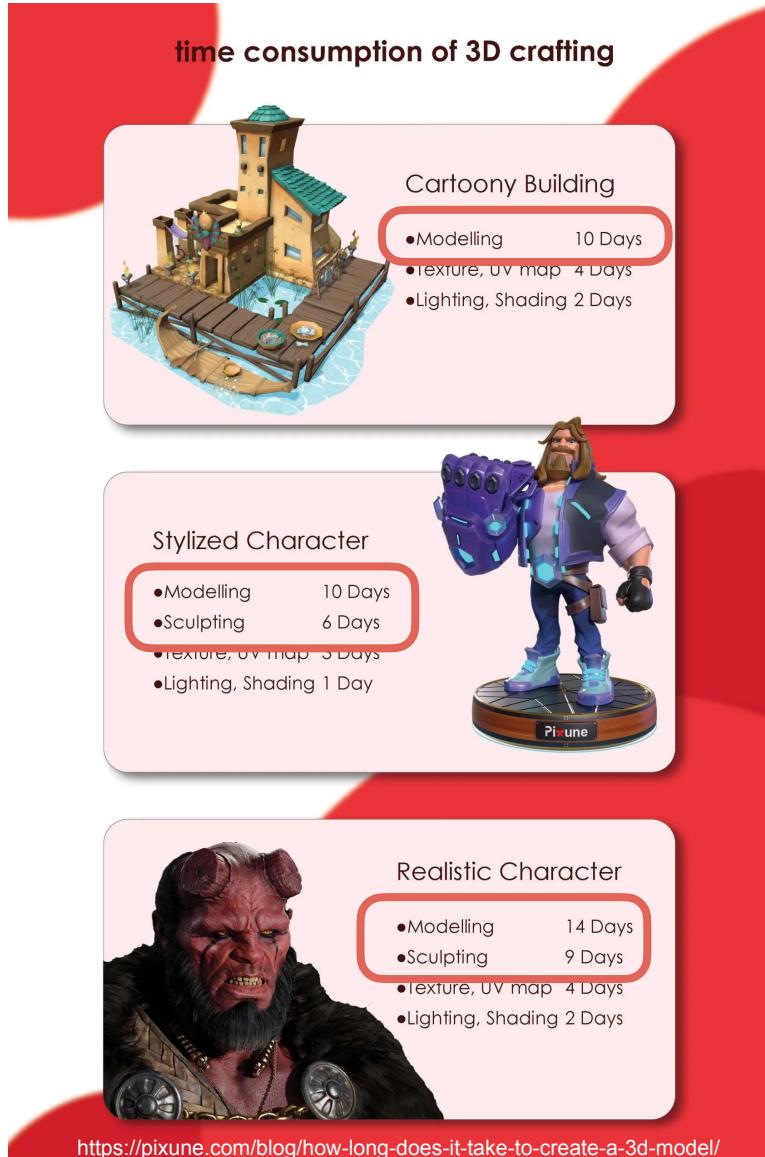


3D Sketches

**Sketch-Based Modeling  
& Animation**

**Creation Process**

# 3D Modeling and Animation is Time-Consuming



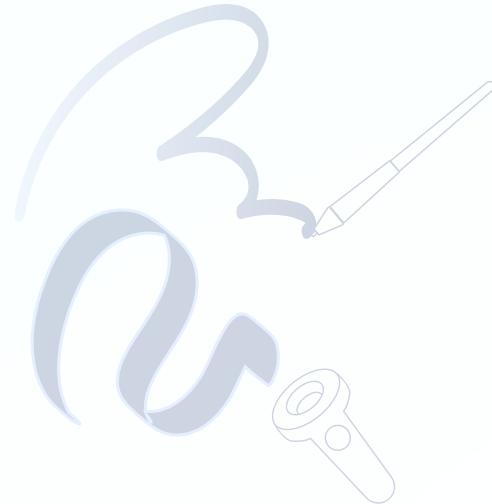
# 3D Modeling and Animation are Time-Consuming

---



## Sketch-Based Approaches

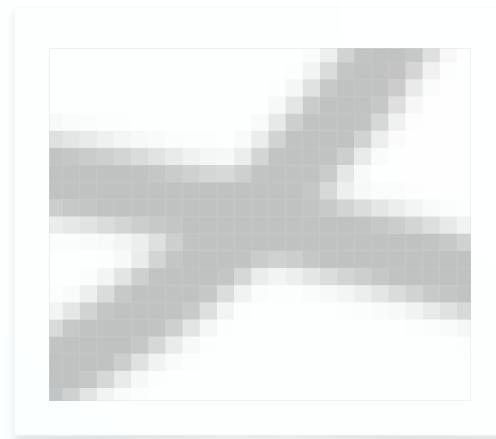
- Intuitive and expressive
- Novice friendly
- Easy to communicate



Tracking Samples



2D Sketches



Raster Samples



3D Sketches



## Sketch-Related Vision Tasks

Models & Animations



Creation Process