PROJECT BUTTERFLY

Party

1×

YOLO / Mask R-CNN warrior

1×

computer graphics wizard

3×

researching hunters

TEAM
CATERPILLAR

Task

Build a butterfly recognition framework which returns a list of potential matches ranked according to the similarity to a query image

The problem involves several subtasks:

- coarse localization of the butterfly
- segmentation

  hint: symmetry, color, shape might be representative features aiding segmentation
- appearance representation and matching

  hint: analyzing the dataset with respect to discriminative features might be necessary
- evaluation

  e.g. how recognition performance depends on the size of the training dataset, which species are similar to each other (confusion)

Please do not perform experiments on live or on captured or on not-live-anymore-but-captured butterflies. Additional butterfly data (beyond the provided link) can be found easily using search engines

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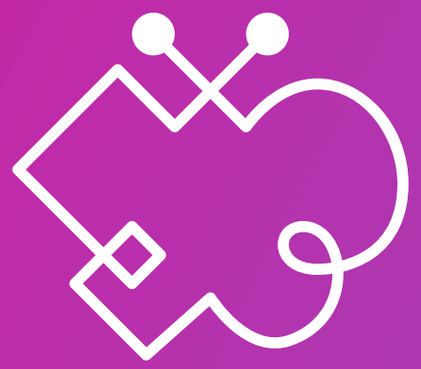
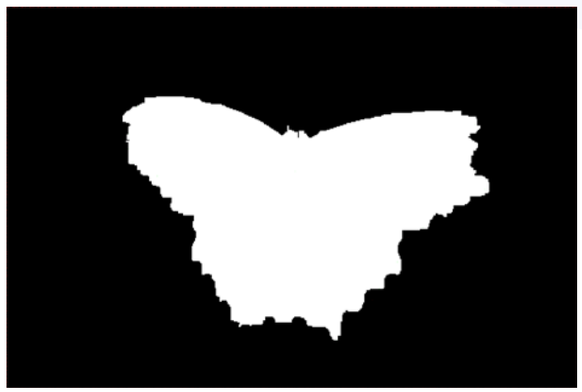
Wing Based Segmentation



Initial Dataset





Related Work

Online website with search engine for butterflies:

- https://butterfly-conservation.org/butterflies/identify-a-butterfly
- http://gardenswithwings.com/identify-butterflies.html
- https://www.discoverlife.org/mp/20q?guide=Butterflies
- https://butterflyconservationsa.net.au/butterflies/identify/online-identification-tool/

Related Work

Computer Vison and butterflies:

- **Butterfly detection and classification based on intgerated YOLO algorithm**

  https://www.groundai.com/project/butterfly-detection-and-classification-based-on-integrated-yolo-algorithm/1

- **Butterfly Species Identification Using Convolutional Neural Network (CNN)**

  https://ieeexplore.ieee.org/abstract/document/8825031

- **Butterfly Recognition Based on Faster R-CNN**

  https://iopscience.iop.org/article/10.1088/1742-6596/1176/3/032048

- **Classify butterfly images with deep learning in Keras**

  https://towardsdatascience.com/classify-butterfly-images-with-deep-learning-in-keras-b3101fe0f98

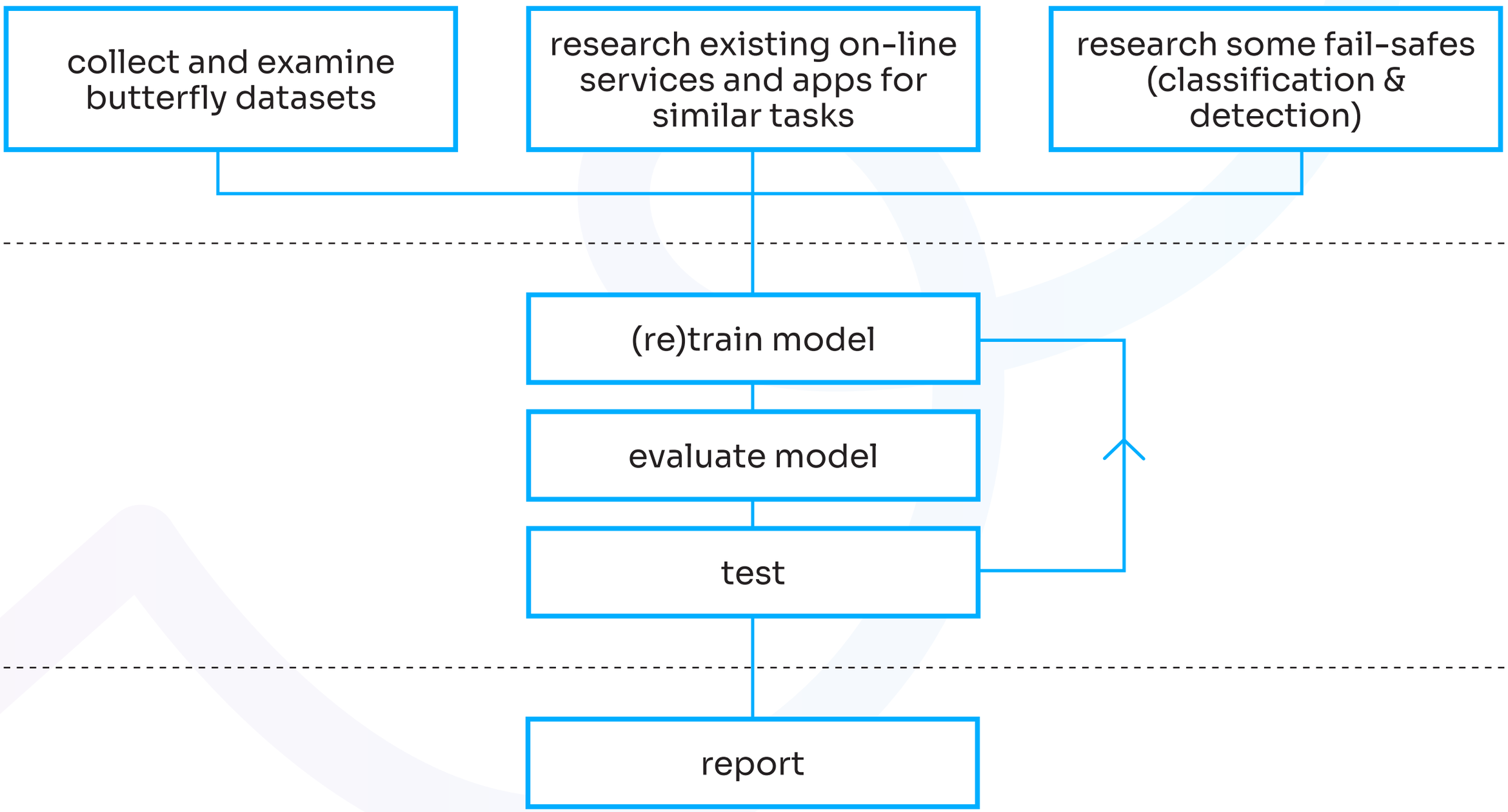
- **The Automatic Identification of Butterfly Species**

  https://arxiv.org/abs/1803.06626

- **Butterfly Species Recognition Using Artificial Neural Network**

  https://www.researchgate.net/publication/324814938_Butterfly_Species_Recognition_Using_Artificial_Neural_Network

Roadmap

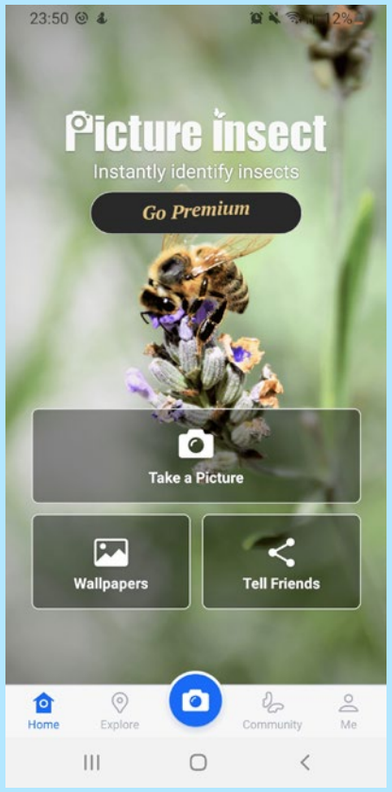

collect and examine butterfly datasets
research existing on-line services and apps for similar tasks
research some fail-safes (classification & detection)
(re)train model
evaluate model
test
report

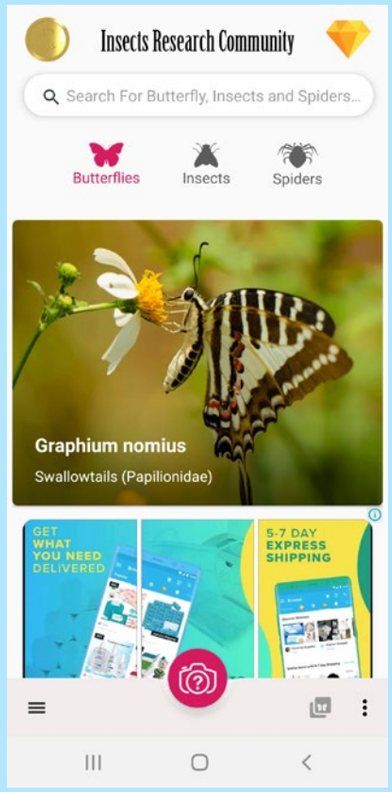
Fail-safes

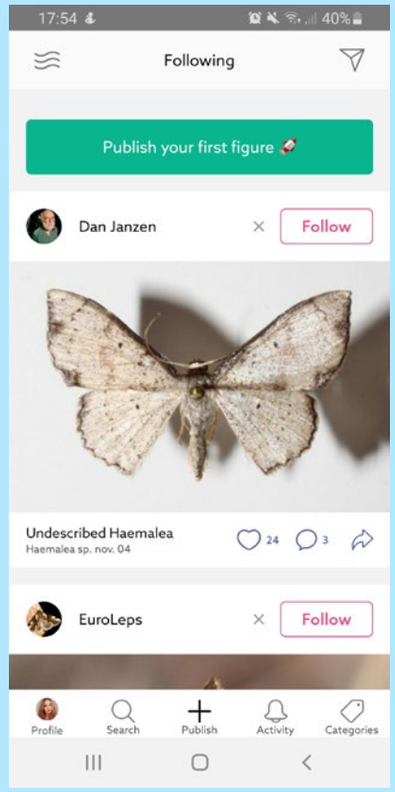
Azure

VGG16

Competition





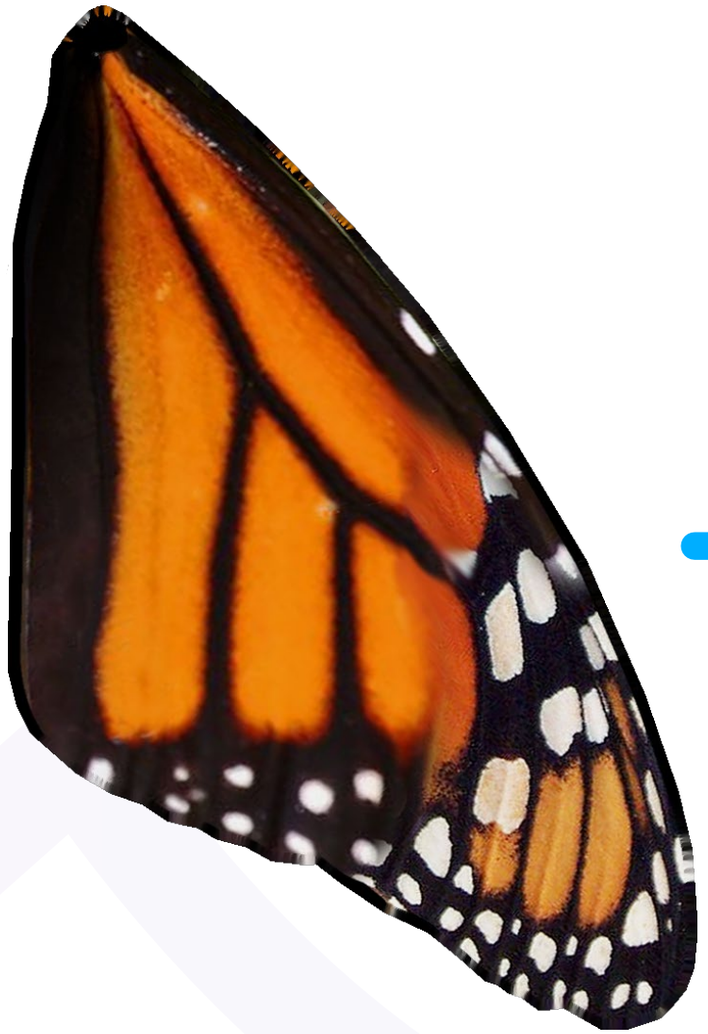


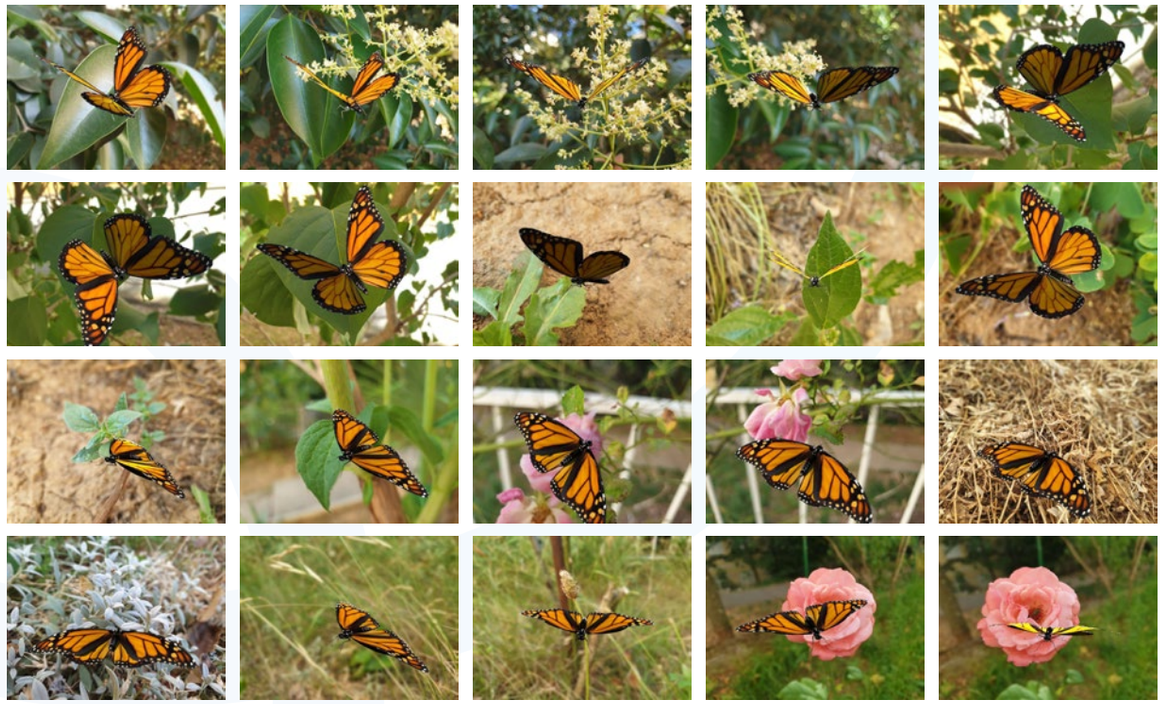
APP	Picture Insect – Insect Id Pro	Insect Identifier: Insect ID, AI Photo Camera	Insect Identifier App by Photo, Camera 2020	Leps by Fieldguide
FREE	✗	✓	✓	✓
CAN RECOGNIZE	✓	✗	✗	✗

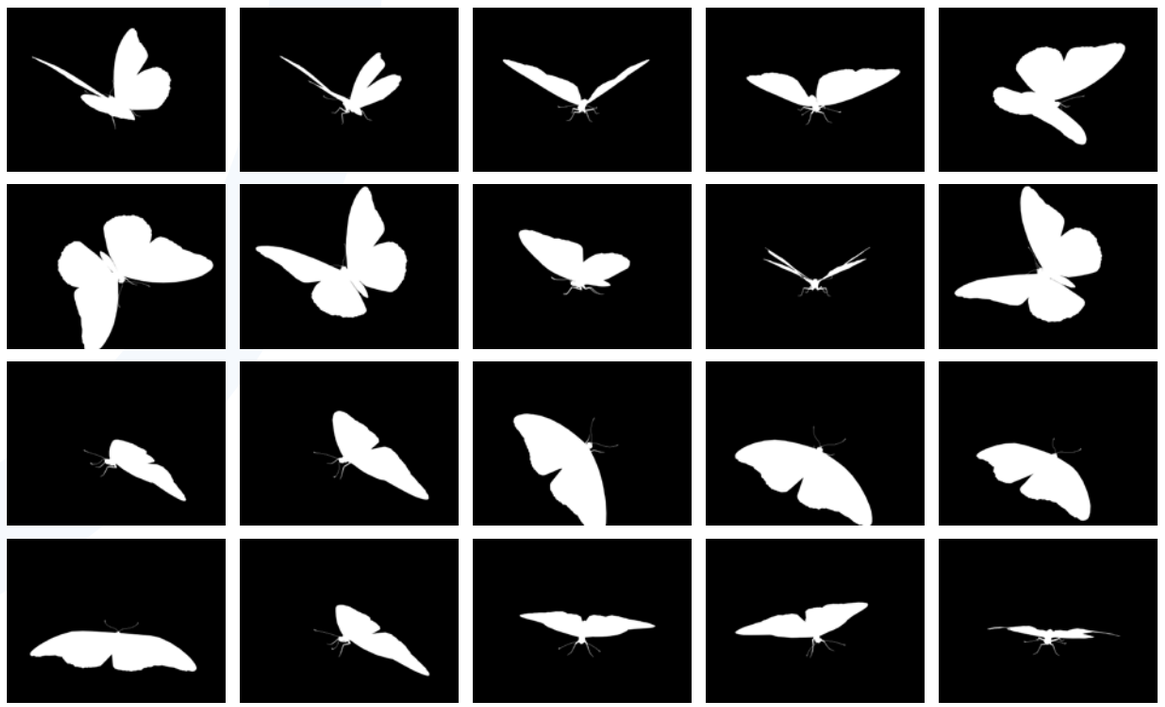
Datasets

- **Leeds Butterfly Dataset**
  http://www.josiahwang.com/dataset/leedsbutterfly/
  (832 images+masks for 10 butterfly categories)
- **Butterfly Images-50 species dataset**
  https://www.kaggle.com/gpiosenka/butterfly-images40-species/
  (3558 images for 50 butterfly categories)
- **Animals-10**
  https://www.kaggle.com/alessiocorrado99/animals10
  (28K animal images belonging to 10 categories)
- **Gábor Németh's Fotóalbum "Nature"**
  (6 images of butterfly)

New Mission







Roadmap: Short Term

research some fail-safes (classification & detection)

annotate some data manually (another fail-safe)

create wing based photorealistic procedural synthset generator

(re)train model

evaluate model

test

report

Roadmap: Long Term

set up a website and brand the project

set up a print-on-demand on-line shop to fund the research

create media hype

---

continue research

produce the data

publish dataset(s) and paper

---

make the product (app) and beat the competition

On-line Environments

Google Spreadsheet

project management

Slack

communication

GitHub

repository

Google Colab

experiments

Azure

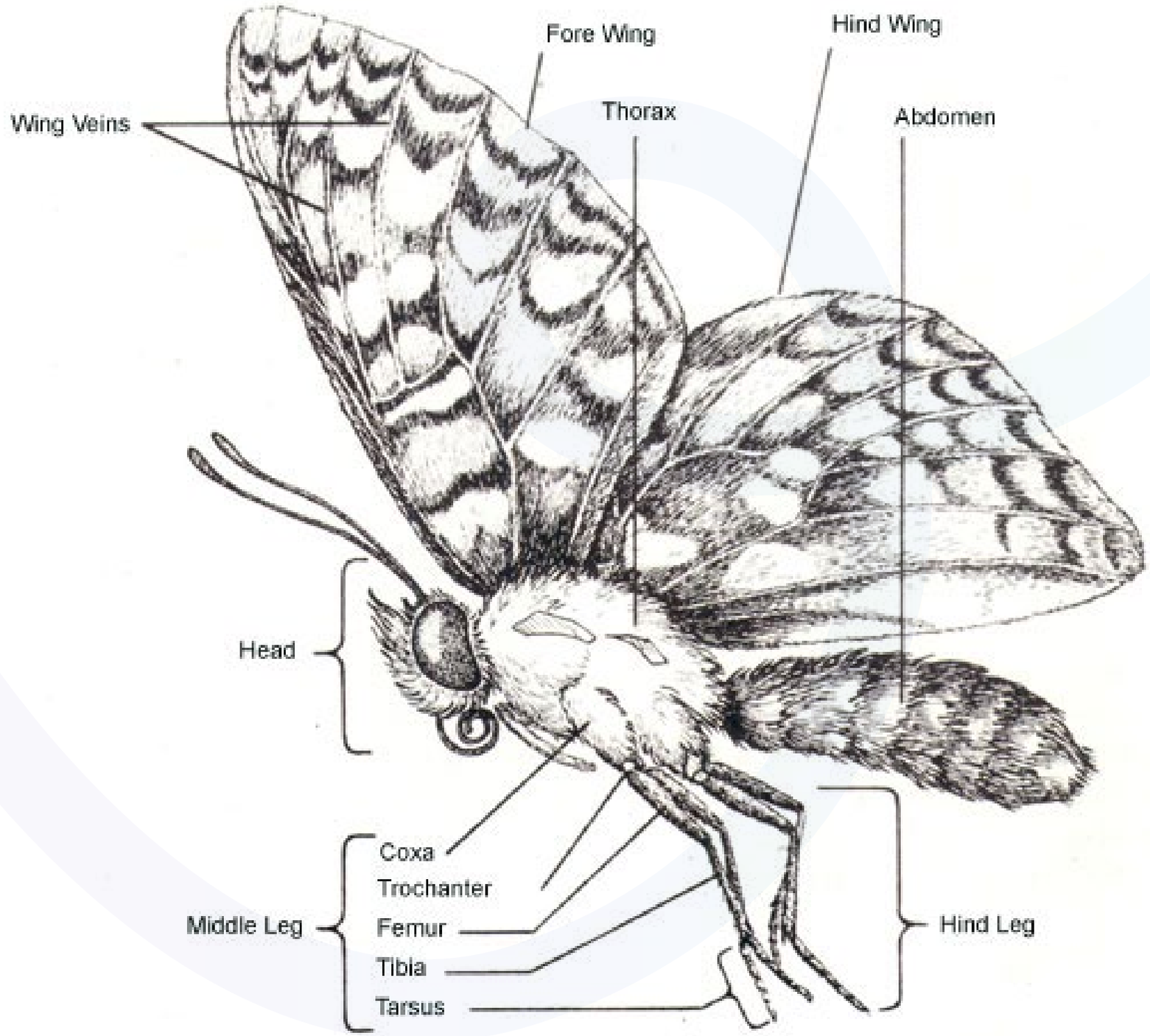
cognitive services

Off-line Environments

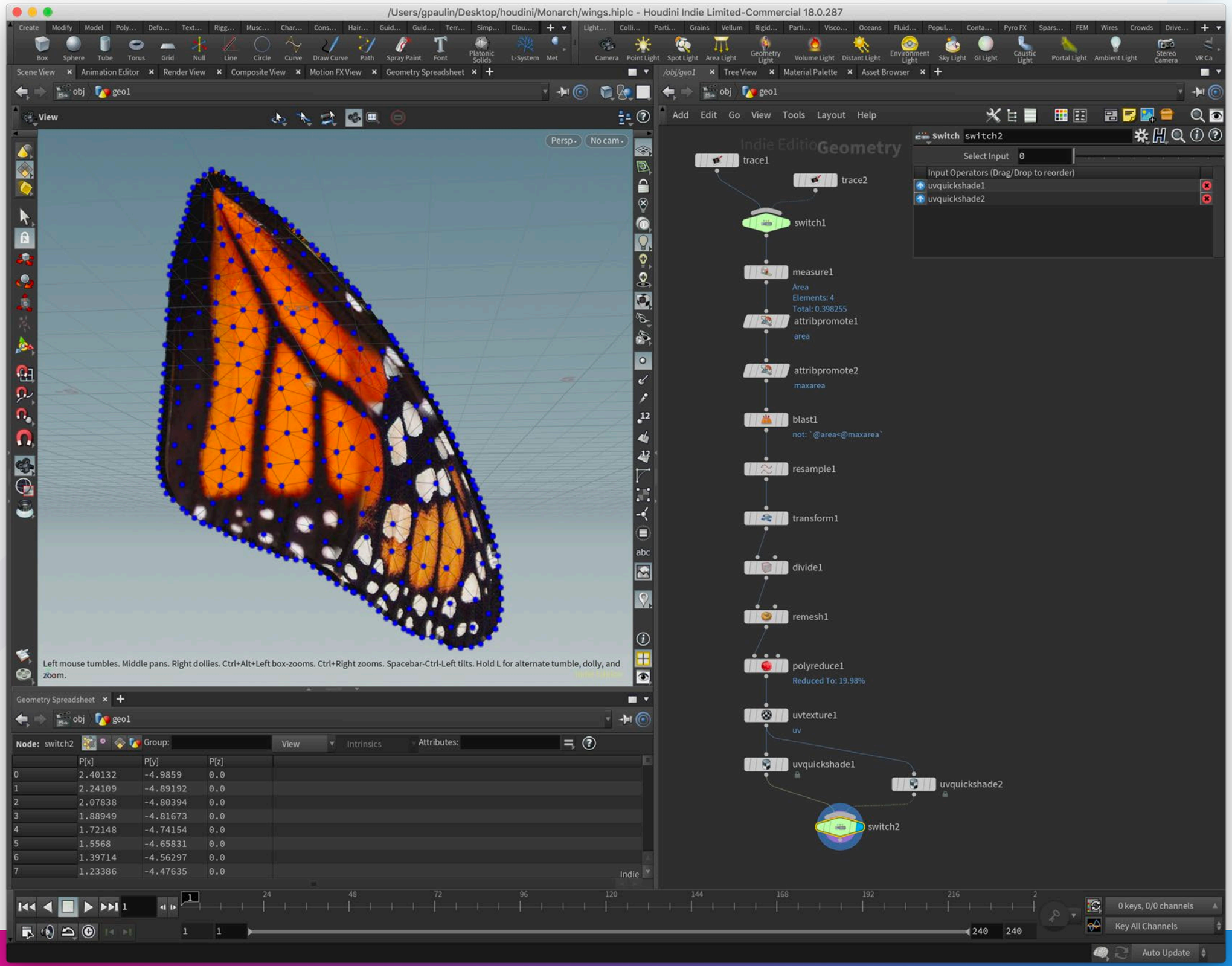
Python + PyTorch
programming

SideFX Houdini
procedural image generation

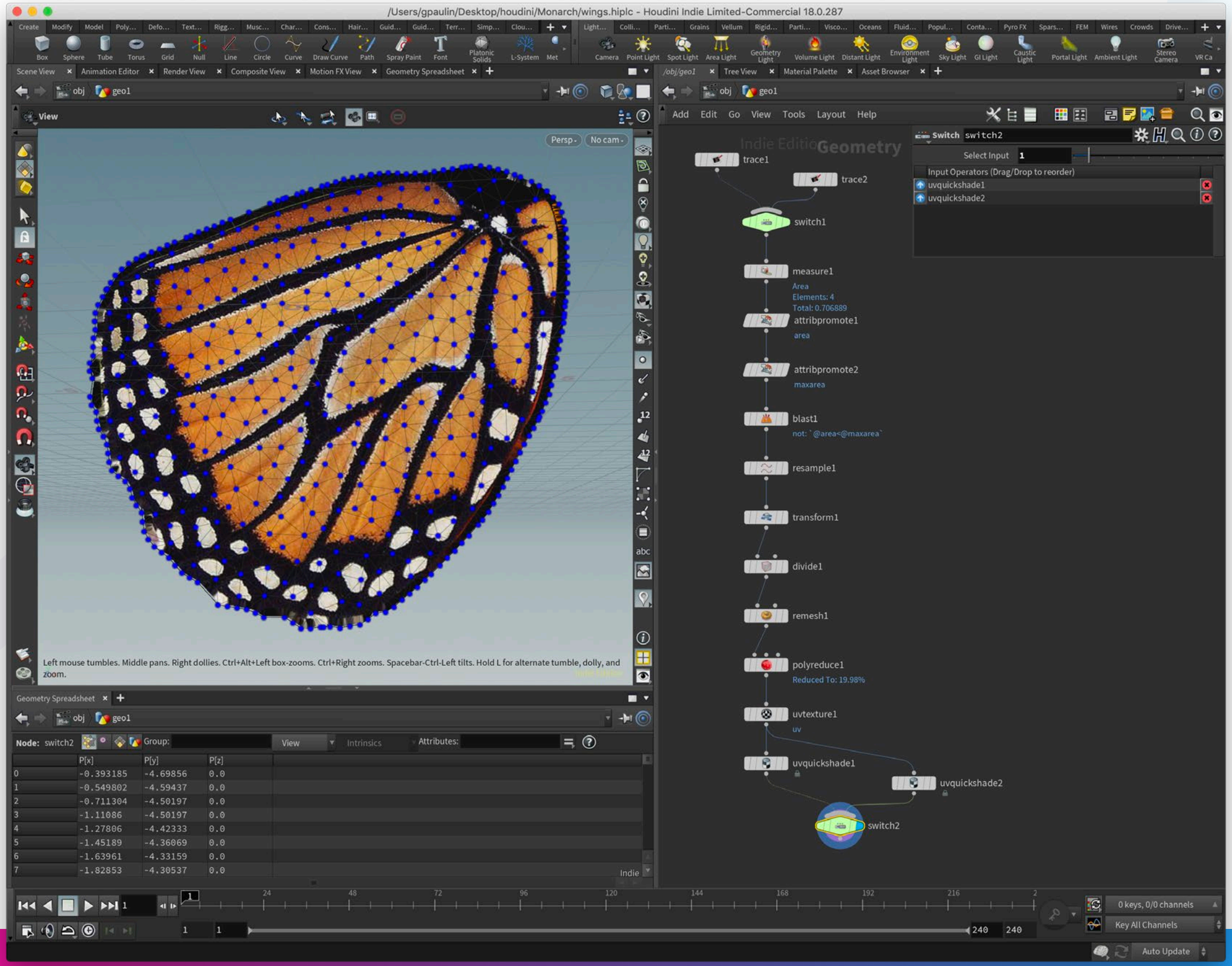
Butterfly Anatomy



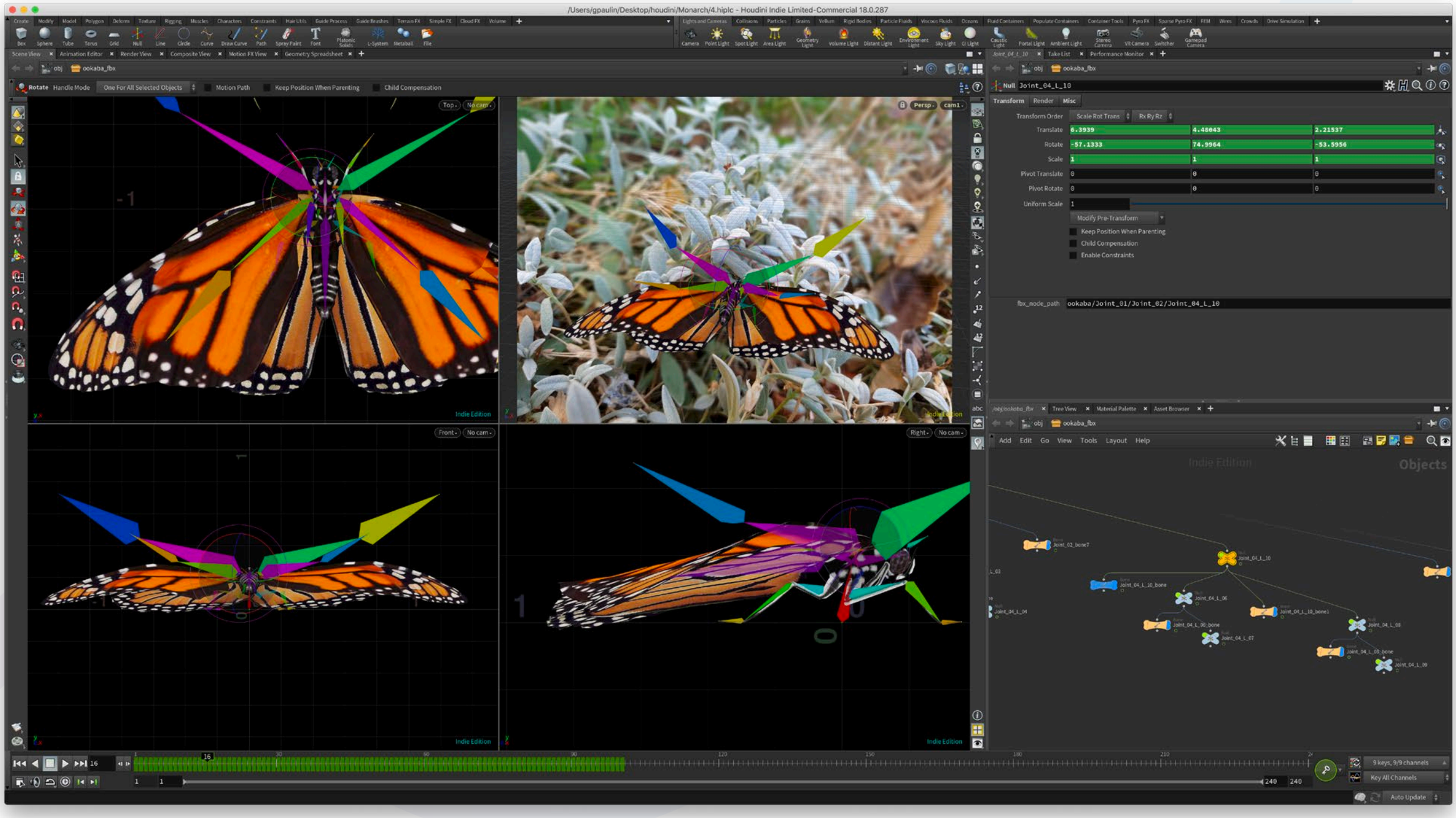
Wing Import


/Users/gpaulin/Desktop/houdini/Monarch/wings.hiplc - Houdini Indie Limited-Commercial 18.0.287
Left mouse tumbles. Middle pans. Right dollies. Ctrl+Alt+Left box-zooms. Ctrl+Right zooms. Spacebar-Ctrl-Left tilts. Hold L for alternate tumble, dolly, and zoom.
Node: switch2
Group:
Attributes:
P[x] P[y] P[z]
0 2.40132 -4.9859 0.0
1 2.24109 -4.89192 0.0
2 2.07838 -4.80394 0.0
3 1.88949 -4.81673 0.0
4 1.72148 -4.74154 0.0
5 1.5568 -4.65831 0.0
6 1.39714 -4.56297 0.0
7 1.23386 -4.47635 0.0
trace1
trace2
switch1
measure1
Area
Elements: 4
Total: 0.398255
attribpromote1
area
attribpromote2
maxarea
blast1
not: `@area<@maxarea`
resample1
transform1
divide1
remesh1
polyreduce1
Reduced To: 19.98%
uvtexture1
uv
uvquickshade1
uvquickshade2
switch2
Select Input
Input Operators (Drag/Drop to reorder)
uvquickshade1
uvquickshade2

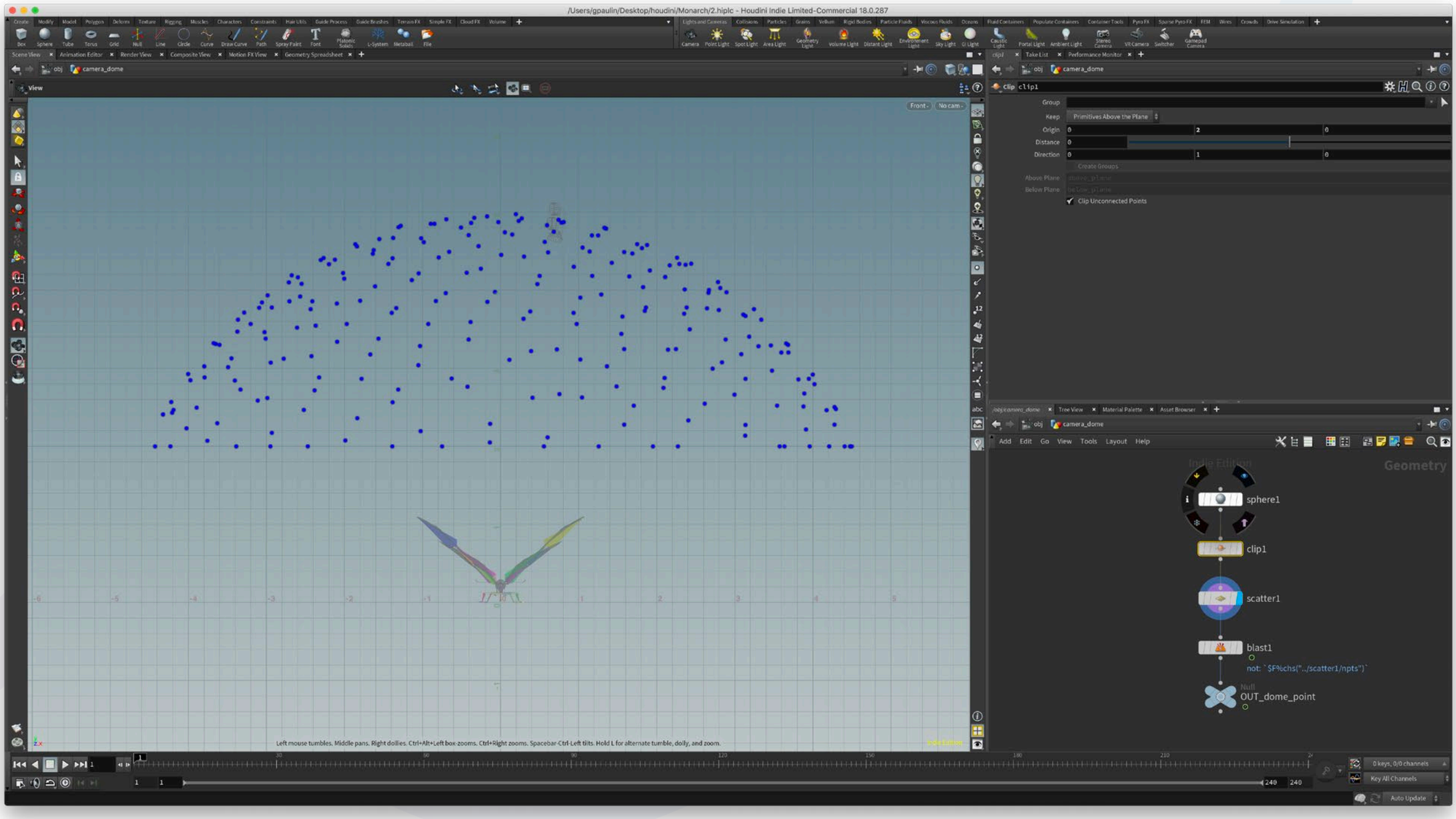
Wing Import


/Users/gpaulin/Desktop/houdini/Monarch/wings.hiplc - Houdini Indie Limited-Commercial 18.0.287
Left mouse tumbles. Middle pans. Right dollies. Ctrl+Alt+Left box-zooms. Ctrl+Right zooms. Spacebar-Ctrl-Left tilts. Hold L for alternate tumble, dolly, and zoom.
Geometry Spreadsheet
Node: switch2
P[x] P[y] P[z]
0 -0.393185 -4.69856 0.0
1 -0.549802 -4.59437 0.0
2 -0.711304 -4.50197 0.0
3 -1.11086 -4.50197 0.0
4 -1.27806 -4.42333 0.0
5 -1.45189 -4.36069 0.0
6 -1.63961 -4.33159 0.0
7 -1.82853 -4.30537 0.0
trace1
trace2
switch1
measure1
Area
Elements: 4
Total: 0.706889
attribpromote1
area
attribpromote2
maxarea
blast1
not: `@area<@maxarea`
resample1
transform1
divide1
remesh1
polyreduce1
Reduced To: 19.98%
uvtexture1
uv
uvquickshade1
uvquickshade2
switch2
Switch switch2
Select Input 1
Input Operators (Drag/Drop to reorder)
uvquickshade1
uvquickshade2
Auto Update

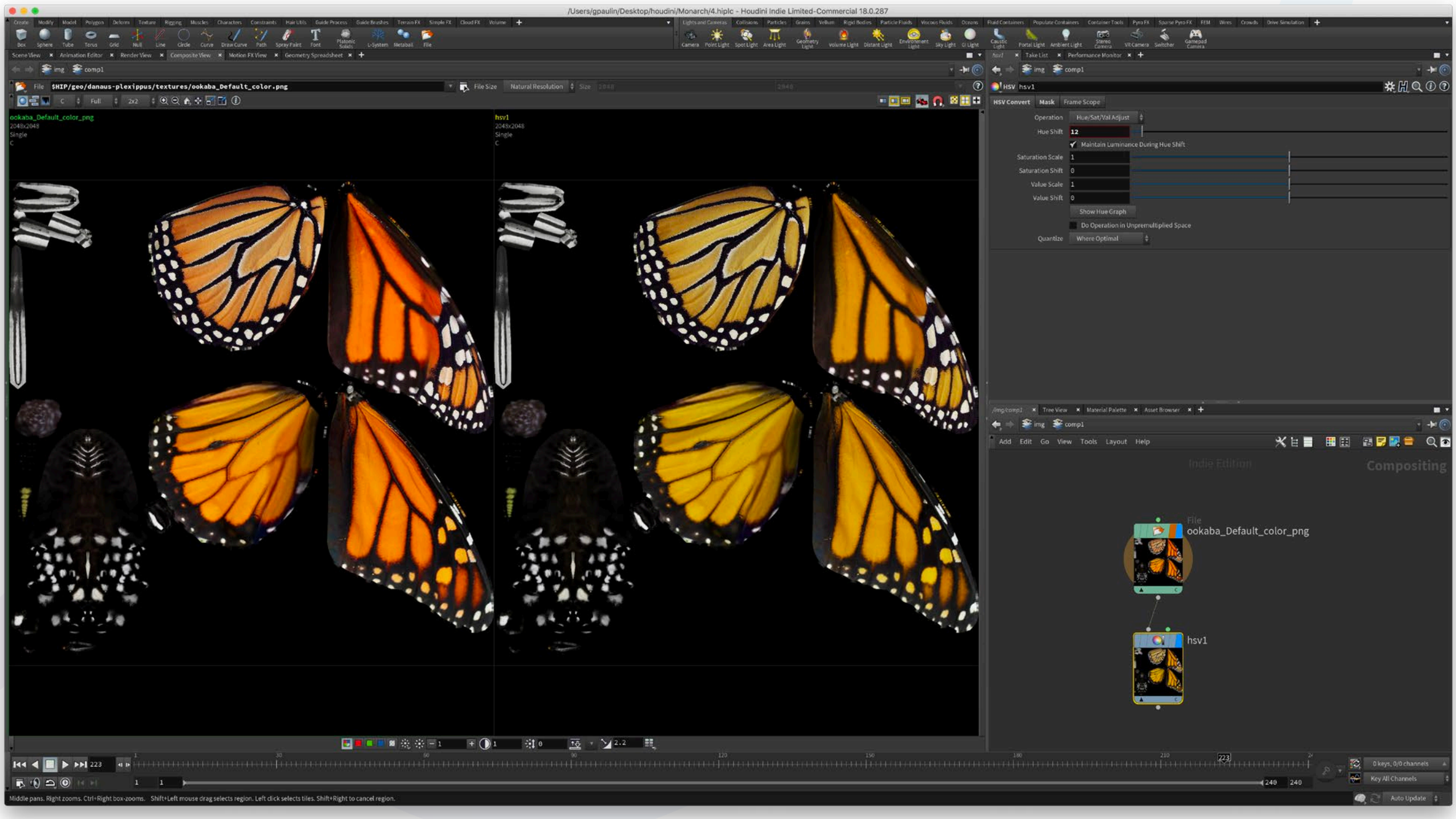
Butterfly Setup



Camera Setup

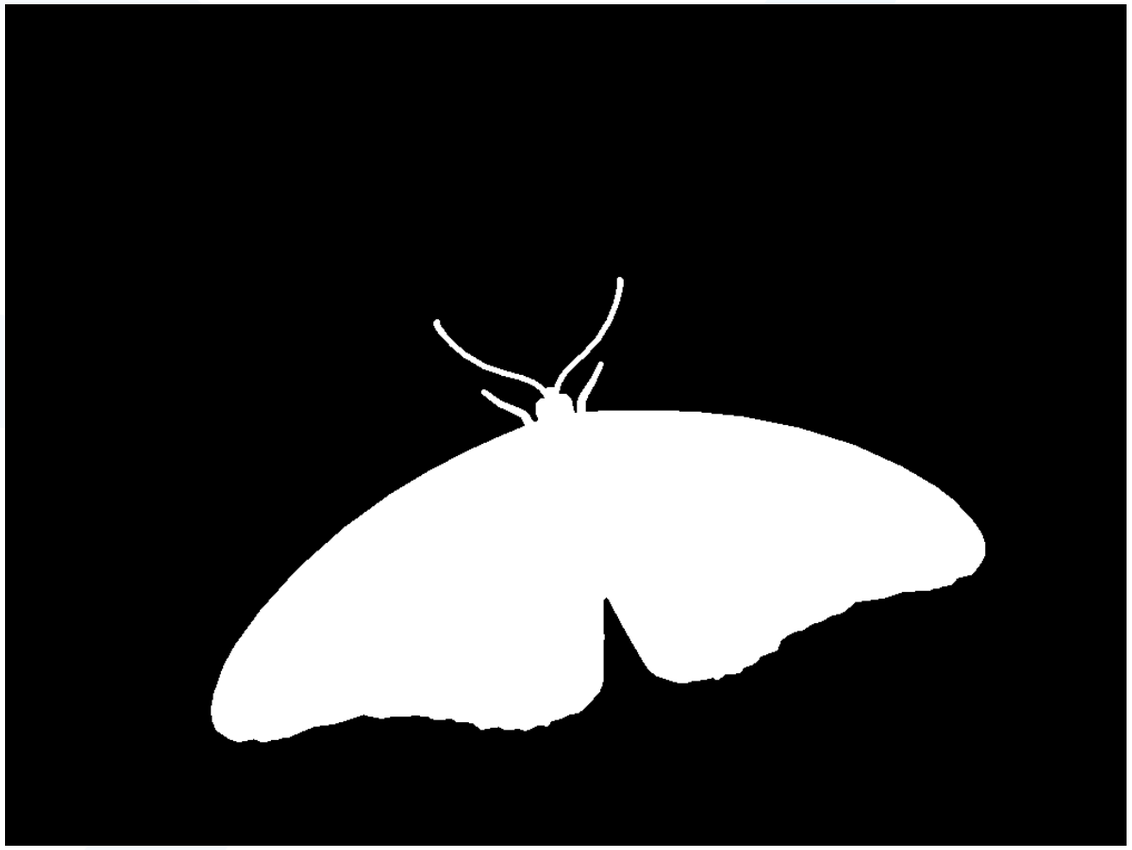


Hue Variations

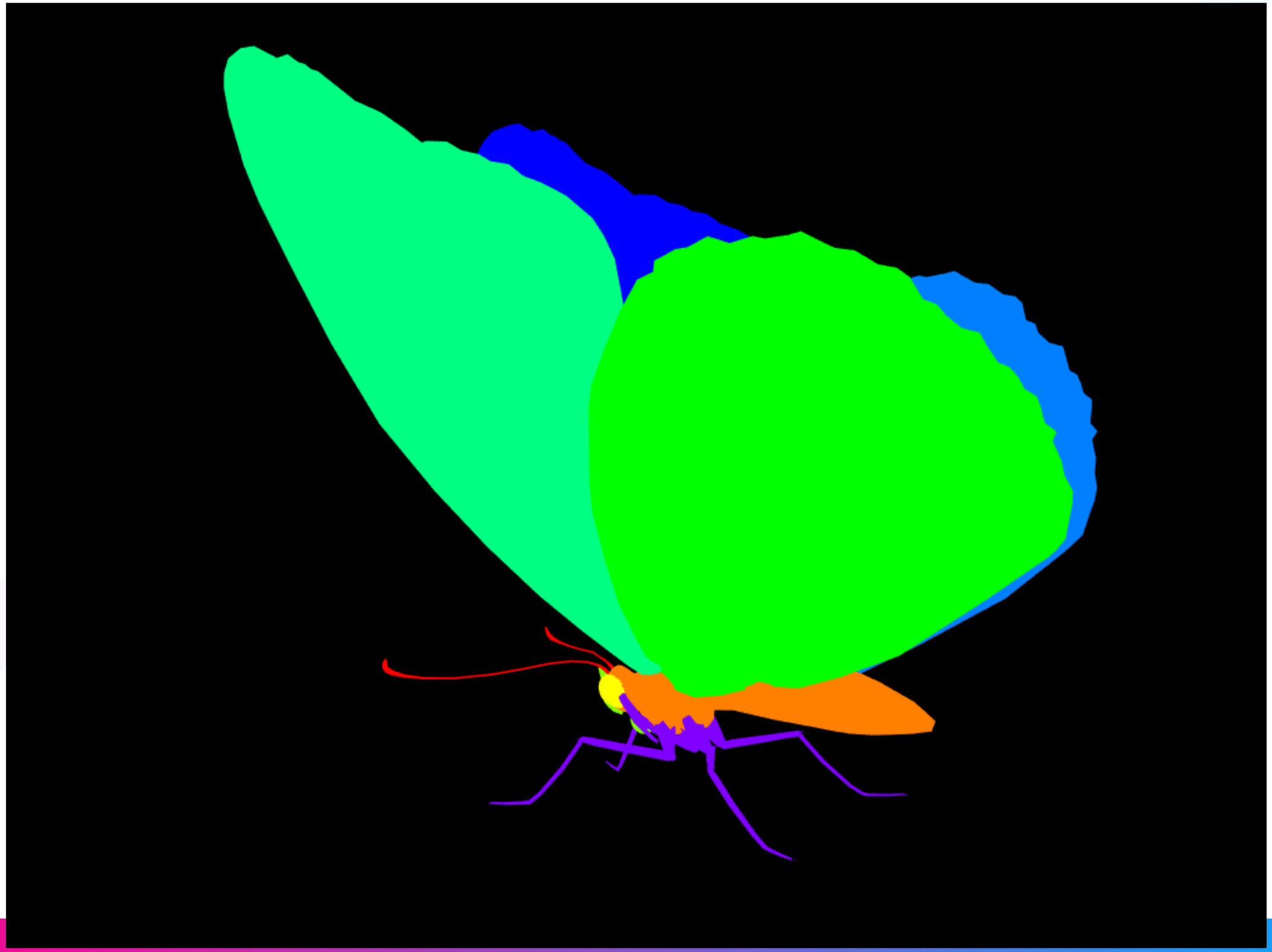


Background Sample

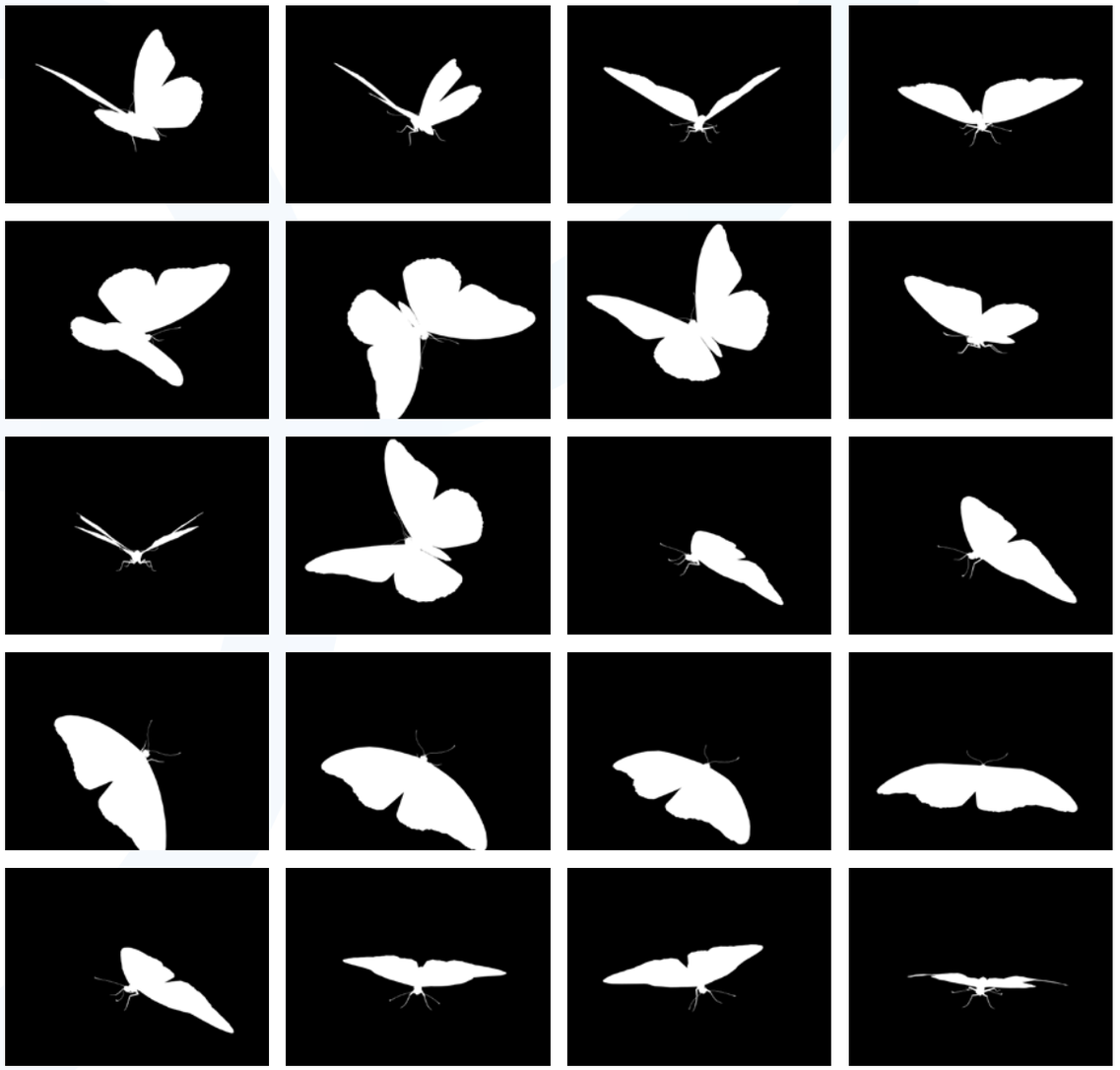
Binary Mask



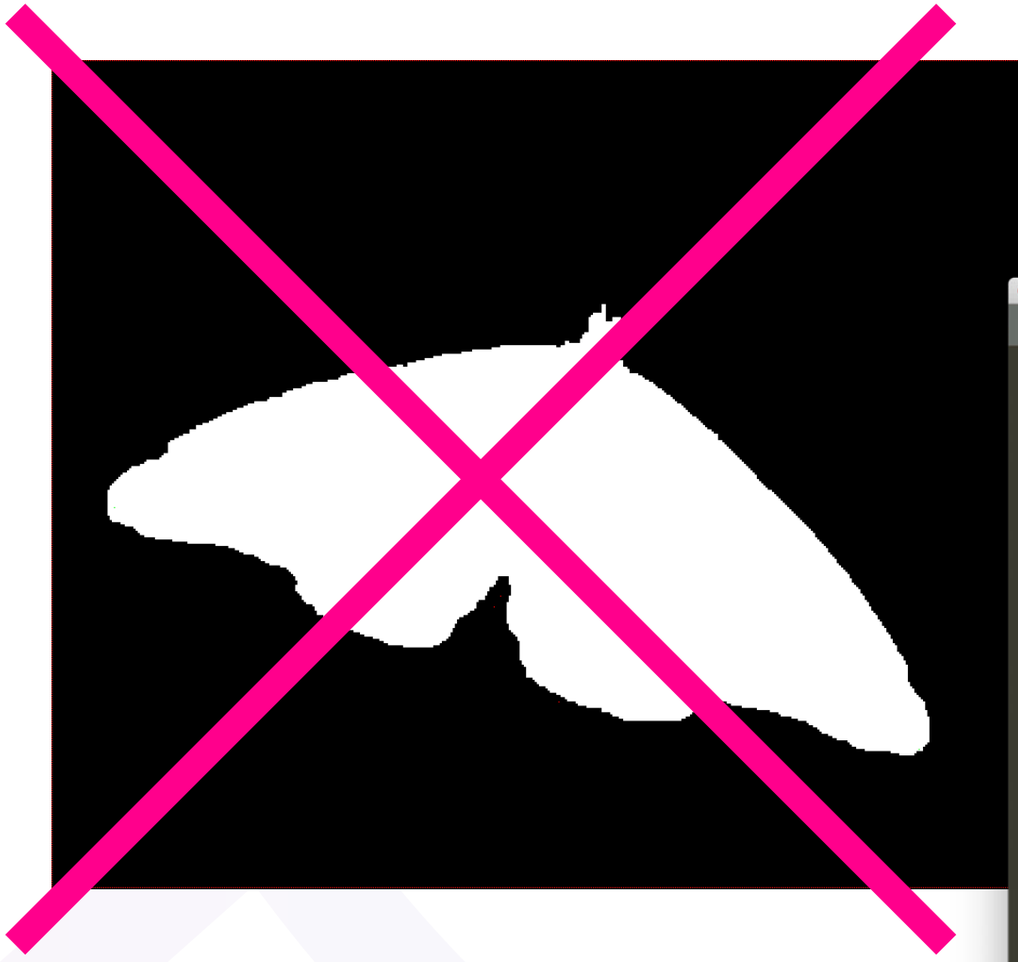
Parts Segmentation



Synth Sets



COCO Problem



coco.json

UNREGISTERED

coco.json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50.5, 135.0, 28.5, 66.0, 10.5, 36.0, 11.0, 6.5, 45.0, 2.5, 91.0, 21.5, 138.5, 61.0, 185.0, 129.5, 204.0, 128.5, 208.0, 137.5,
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194.0, 201.0, 192.5, 199.5, 207.0, 194.0, 208.5, 187.0, 186.5, 157.5, 261.0, 137.5, 271.0, 125.0, 295.5, 109.0, 291.5, 99.0,
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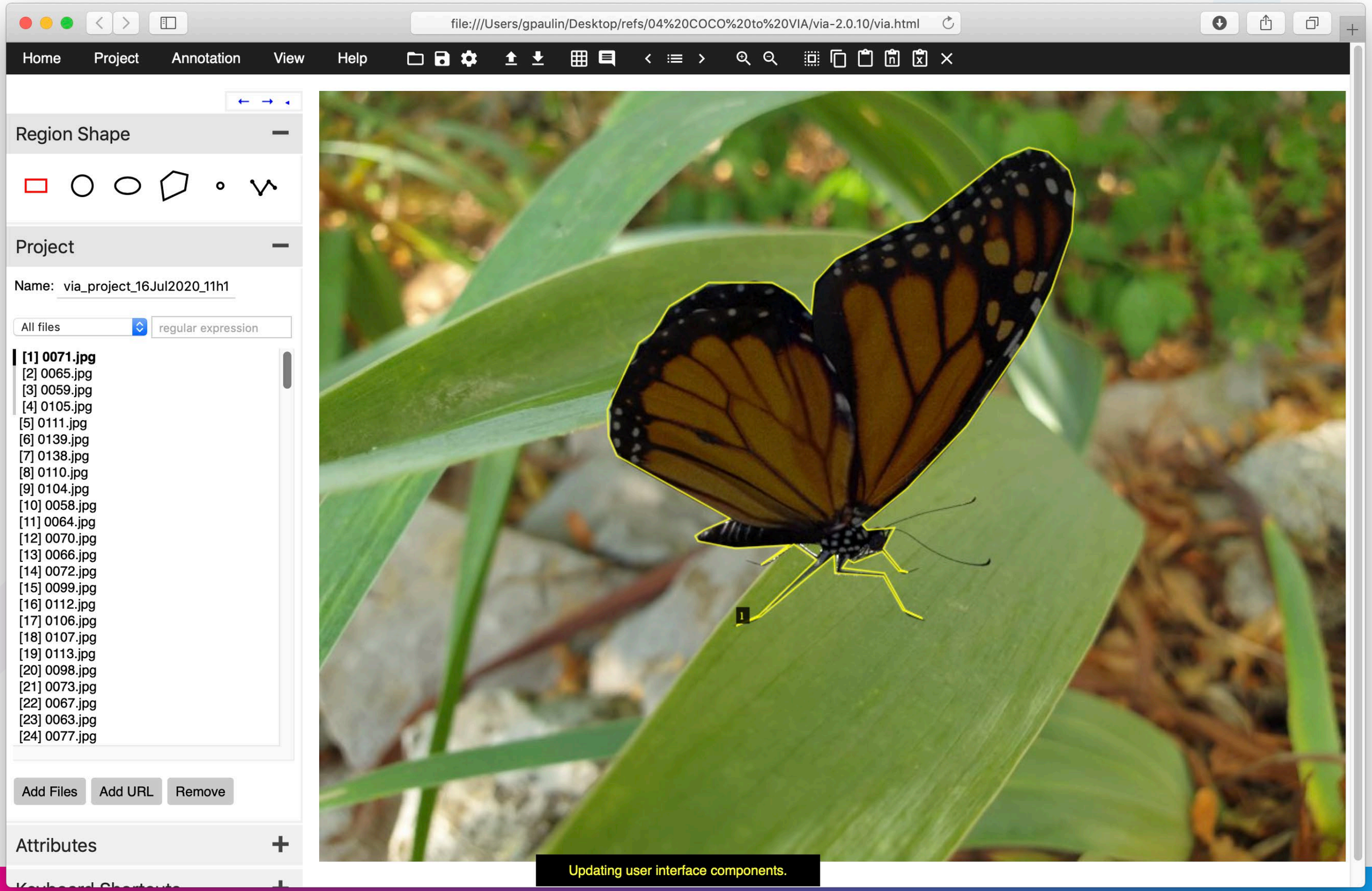
Line 1, Column 1

Tab Size: 4

JSON

VIA Solution



Results

Mask R-CNN: Segmentation

Mask R-CNN: Segmentation

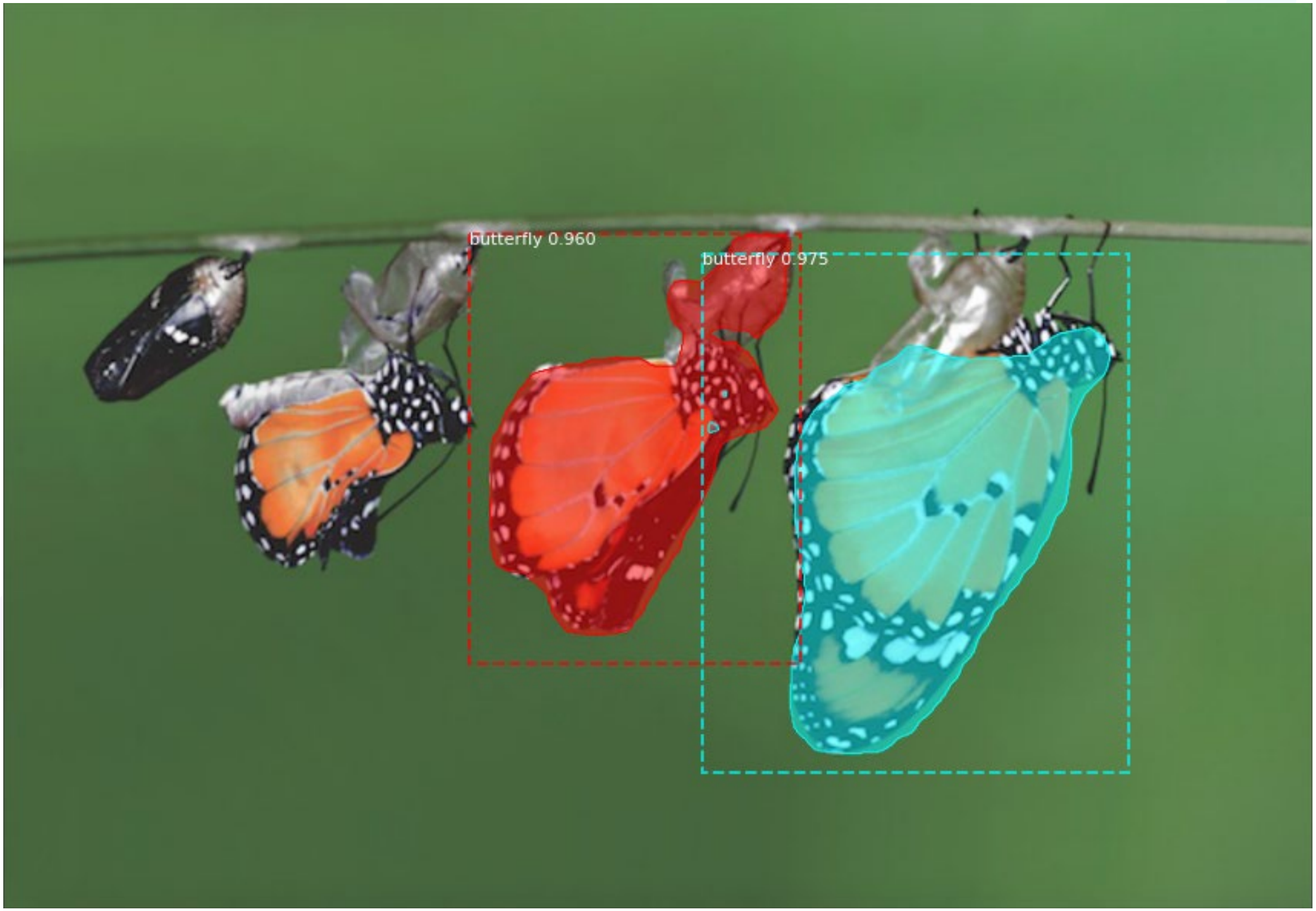
Mask R-CNN: Segmentation

Mask R-CNN: Segmentation

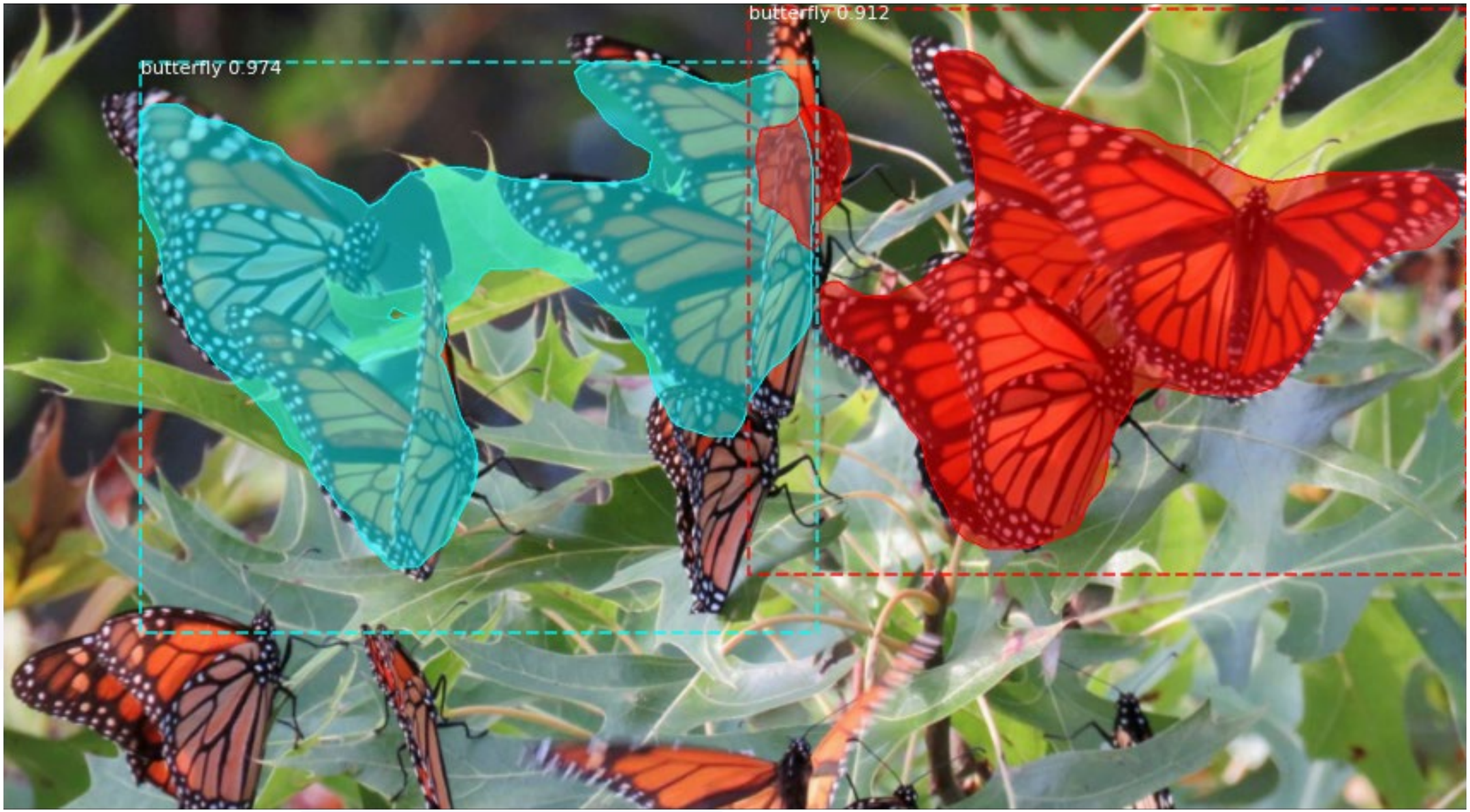
Mask R-CNN: Segmentation

Mask R-CNN: Segmentation

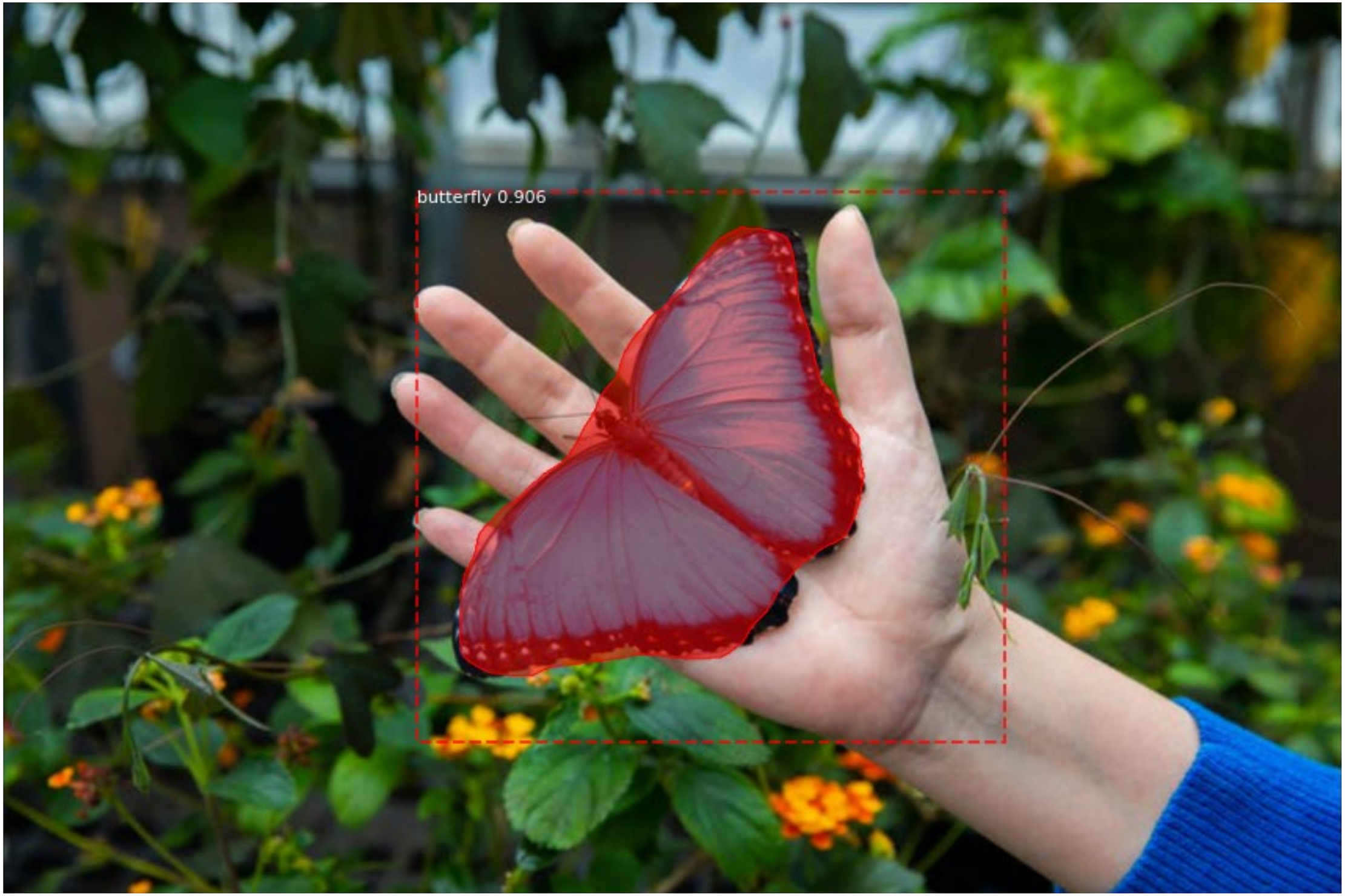
Mask R-CNN: Segmentation



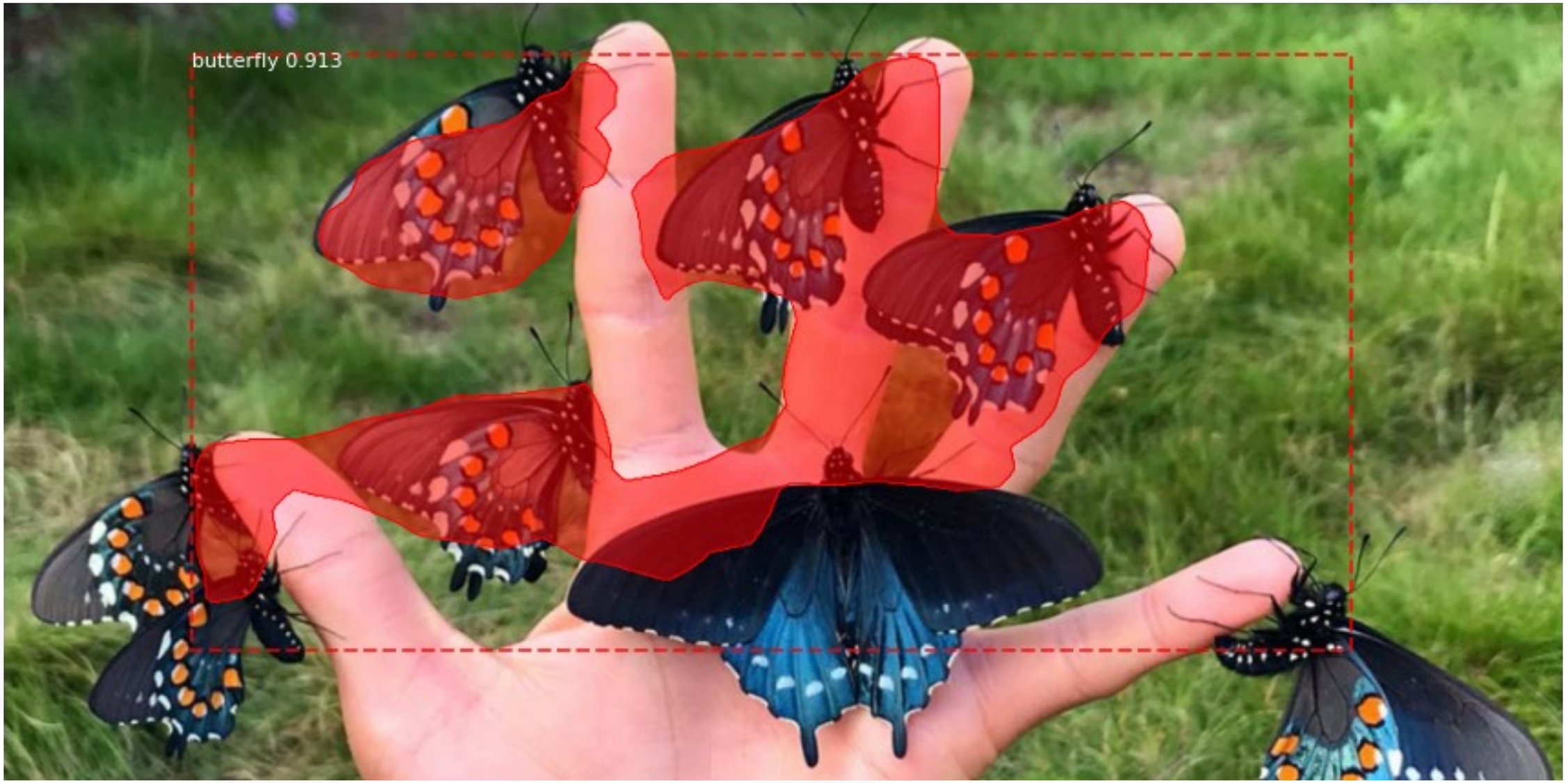
Mask R-CNN: Segmentation



Mask R-CNN: Segmentation



Mask R-CNN: Segmentation



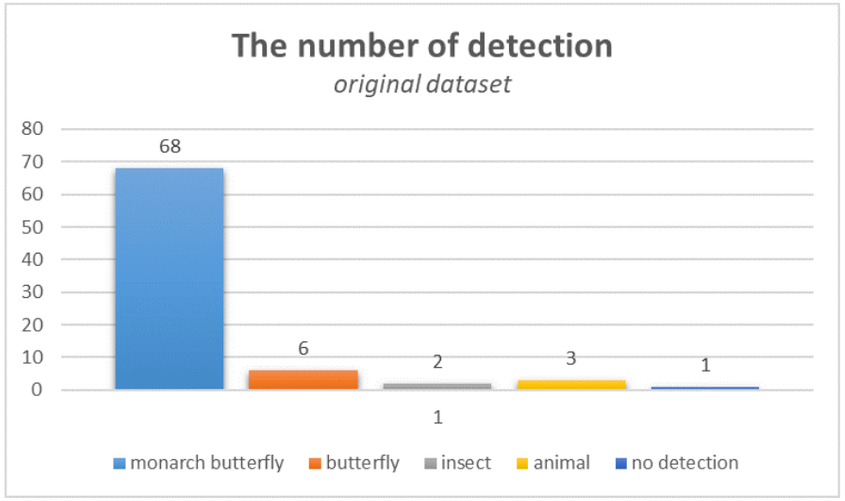
Mask R-CNN: Segmentation

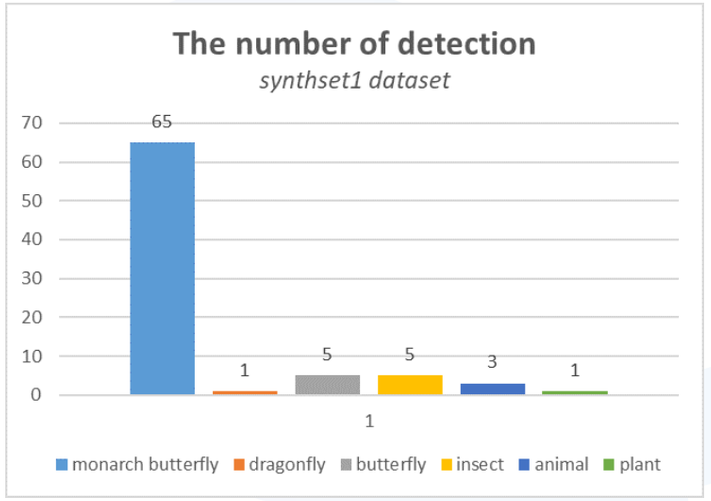
Mask R-CNN: Segmentation

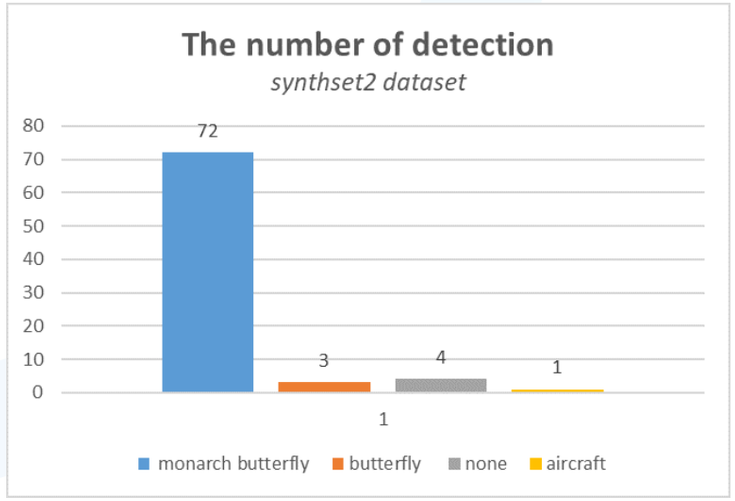
Azure: Detection

FEATURE NAME:	VALUE
Objects	[{ "rectangle": { "x": 170, "y": 148, "w": 180, "h": 171 }, "object": "monarch butterfly", "parent": { "object": "butterfly", "parent": { "object": "Moths and butterflies", "parent": { "object": "insect", "parent": { "object": "Invertebrate", "parent": { "object": "animal", "confidence": 0.849 }, "confidence": 0.827 }, "confidence": 0.826 }, "confidence": 0.823 }, "confidence": 0.823 }, "confidence": 0.808 }, { "rectangle": { "x": 106, "y": 244, "w": 306, "h": 158 }, "object": "flower", "parent": { "object": "plant", "confidence": 0.555 }, "confidence": 0.504 }]
Tags	[{ "name": "butterfly", "confidence": 0.990555167 }, { "name": "moths and butterflies", "confidence": 0.958591163 }, { "name": "insect", "confidence": 0.925485253 }, { "name": "invertebrate", "confidence": 0.915164232 }, { "name": "flower", "confidence":

Azure: Statistics

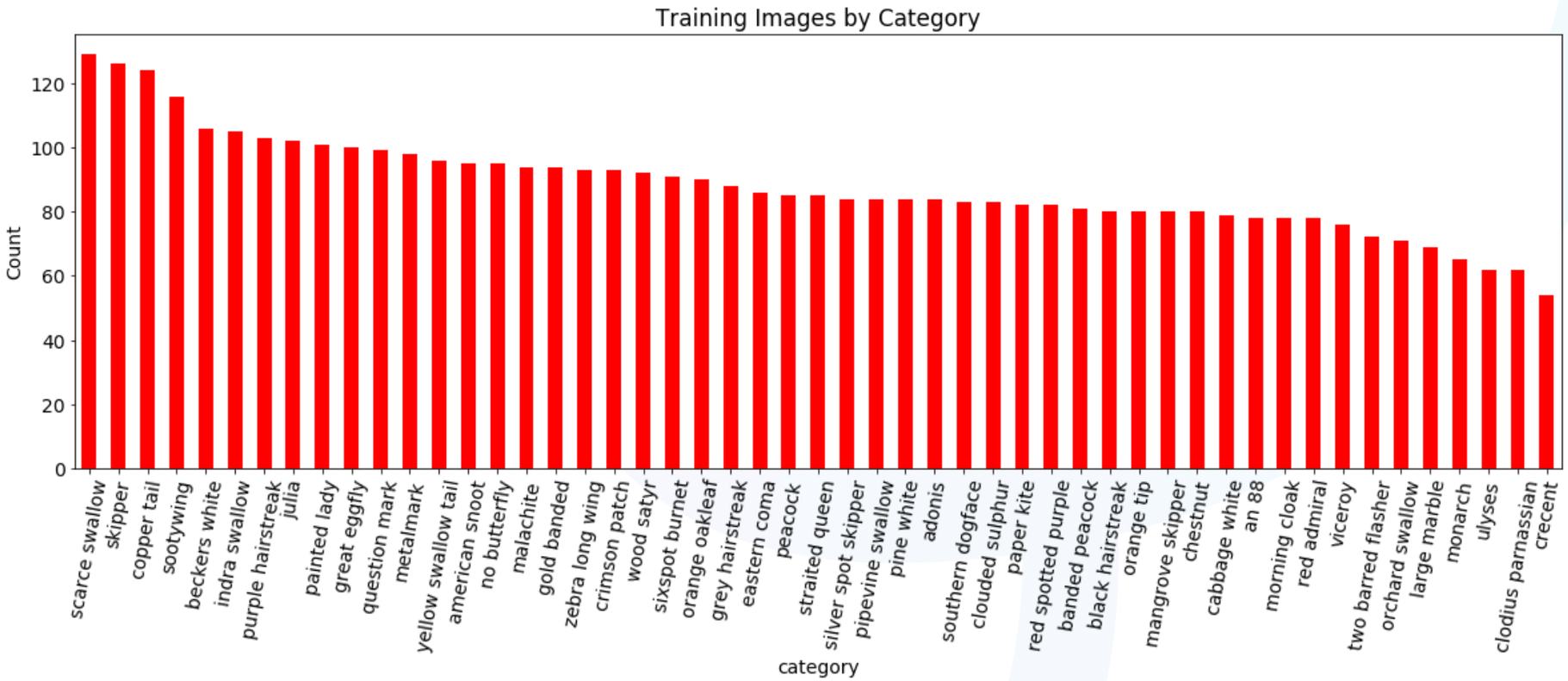


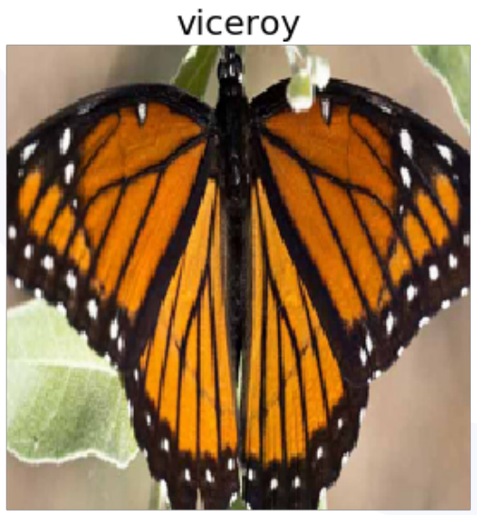


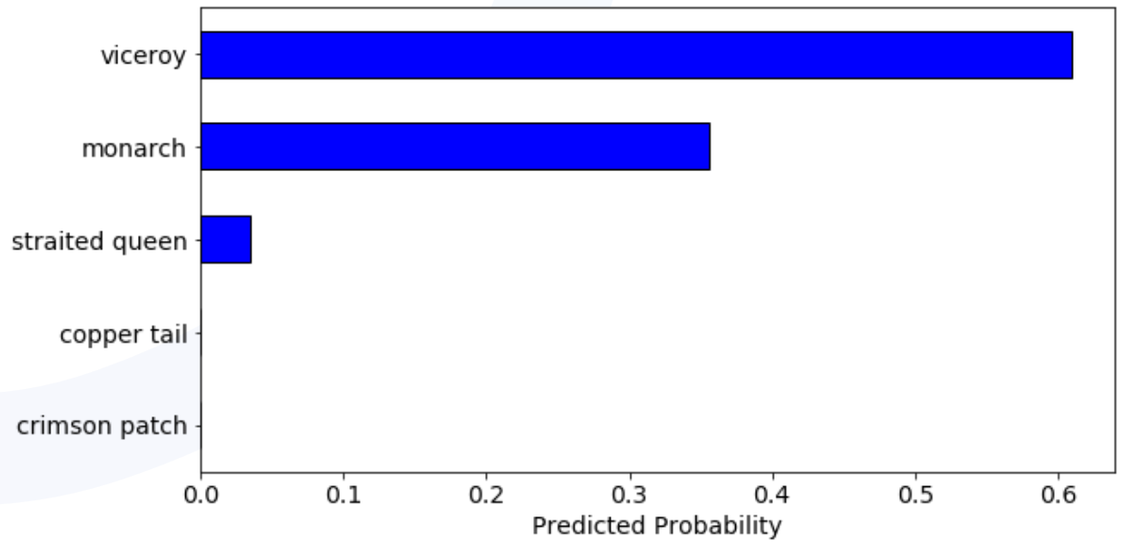


	Original dataset	Synthset1	Synthset2
Percentage of TP detection	85%	81,24%	90%
Mean confidence of the predicted MB	0,78	0,76	0,78
Mean total confidence for MB	0,67	0,61	0,70

VGG16: Classification







Member Contributions

member	Goran Paulin	Kristina Host	Lien Le Phuong Nguyen	Matija Burić	Jinsong Liu
research		lead	assistant		assistant
experiments			detection	segmentation	classification
synth sets	✓				
photo set		✓			
presentation	✓				
presenter					✓
documentation	assistant	lead	assistant	assistant	assistant
manager	✓				

Overall Contributions

1×

photo dataset

(80 images)

2×

synth datasets

(480 images with annotations as binary masks and in both COCO and VIA formats)

achieving

27.7 mAP

causing the butterfly effect

On-line Documentation

https://github.com/khost95/SSIP-2020-Project-Butterfly/

Thank you!

Questions?