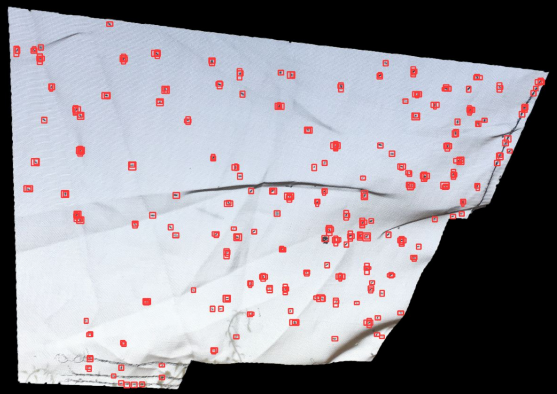


Training a YOLOv5 Object Detection Model for Drosophila Census Task

Andy V. Huynh

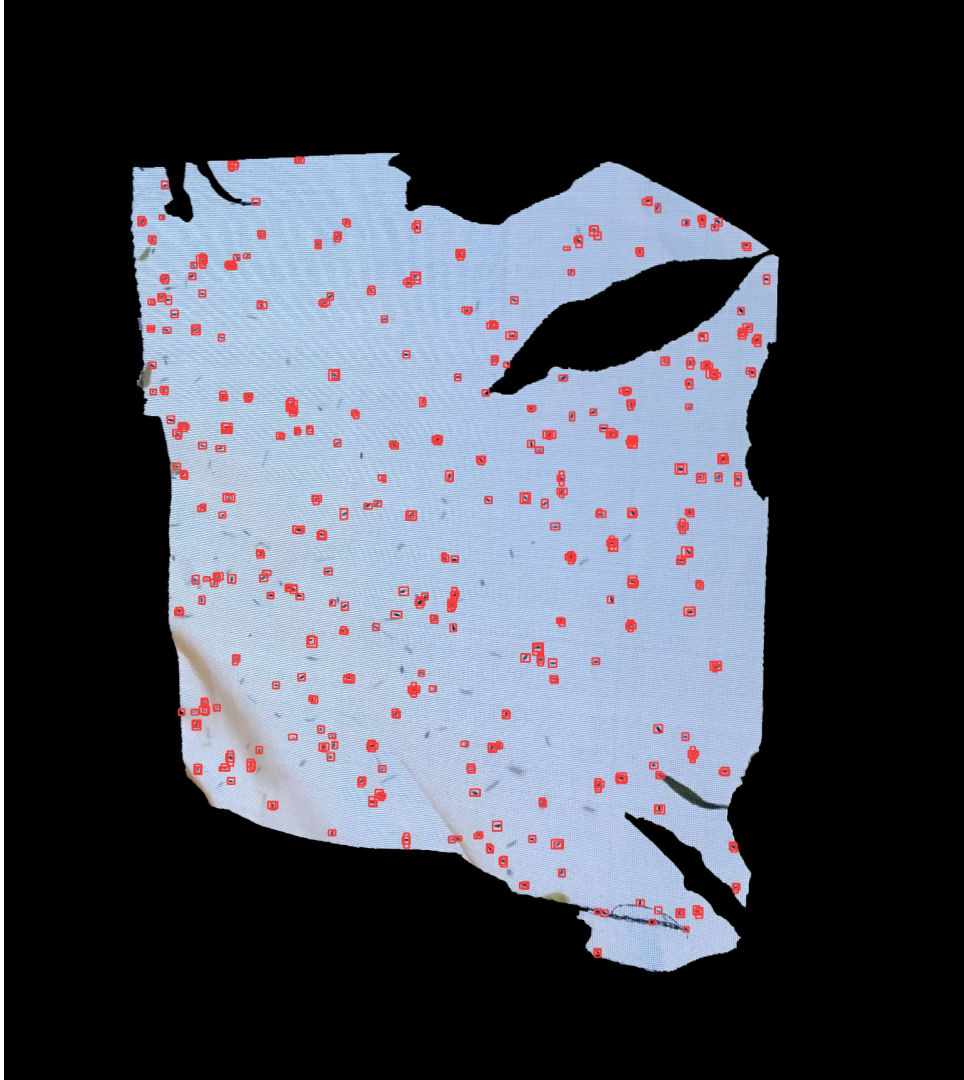
8/5/2022

Today…

I. Approaches in Computer Vision

II. Previous Methods

III. Updates using YOLOv5 Model



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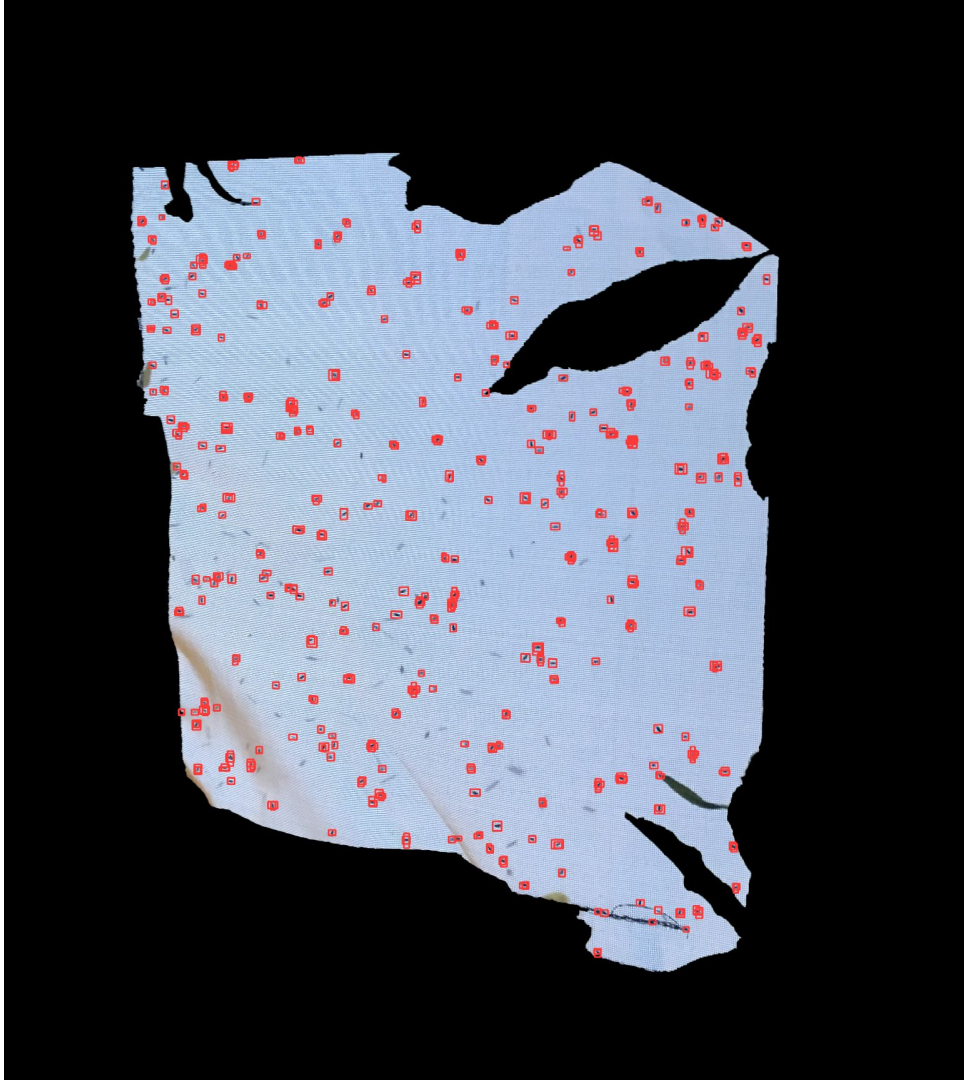


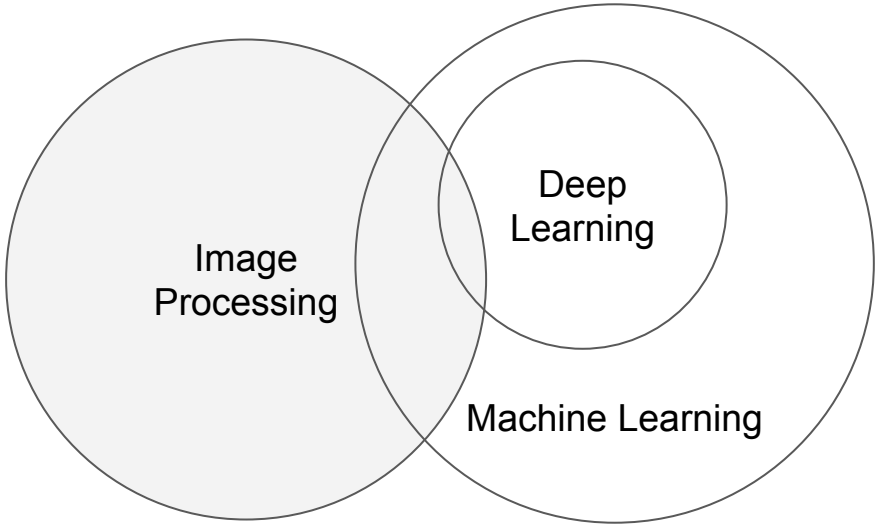
Approaches in Computer Vision

I. Image Processing

II. Machine Learning

III. Deep Learning

(State of the Art)

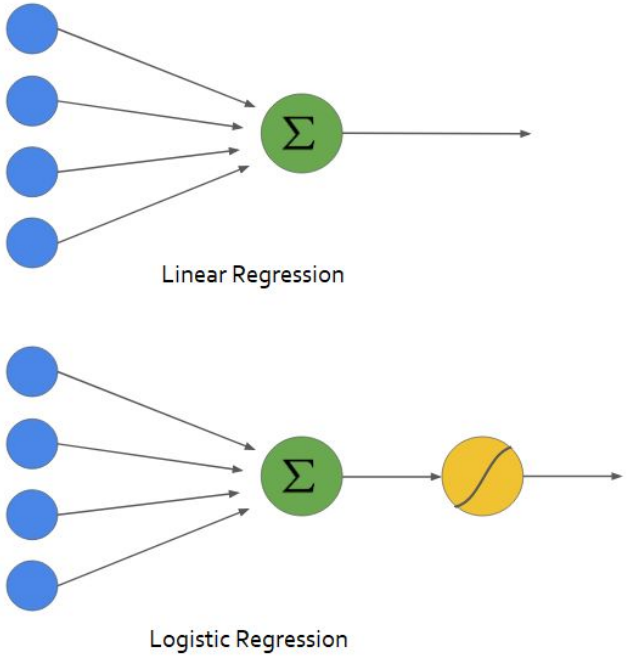


Approach I: Image Processing

Pixel manipulation & analysis

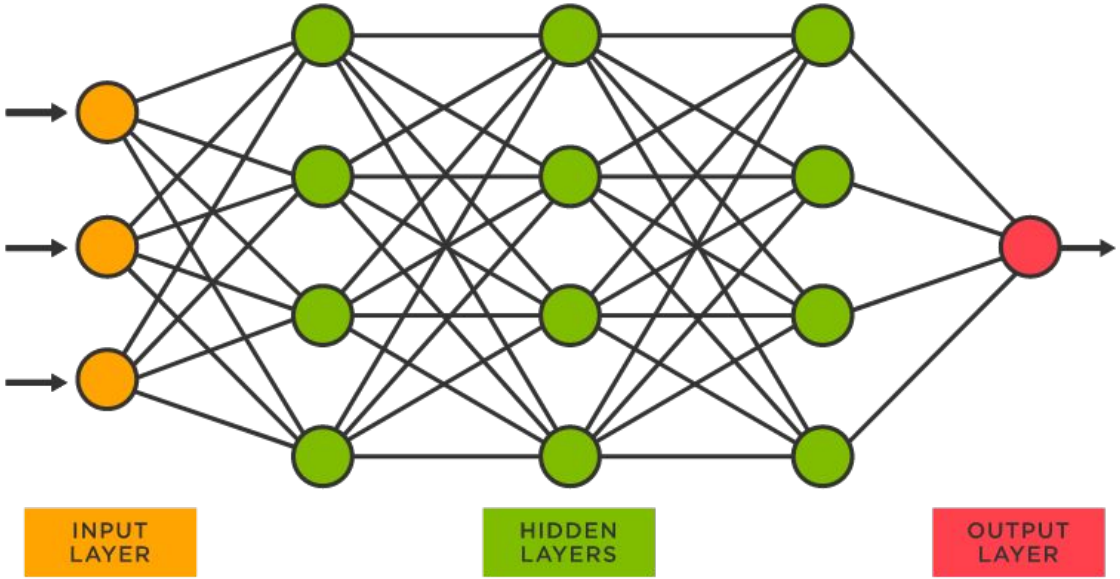
Approach II : Machine Learning

Machine “learns” from data



Approach III: Deep learning

Uses neural networks



Deep Learning Vs Machine Learning

Factors	Deep Learning	Machine Learning
Data Requirement	Requires large data	Can train on lesser data
Accuracy	Provides high accuracy	Gives lesser accuracy
Training Time	Takes longer to train	Takes less time to train
Hardware Dependency	Requires GPU to train properly	Trains on CPU
Hyperparameter Tuning	Can be tuned in various different ways.	Limited tuning capabilities

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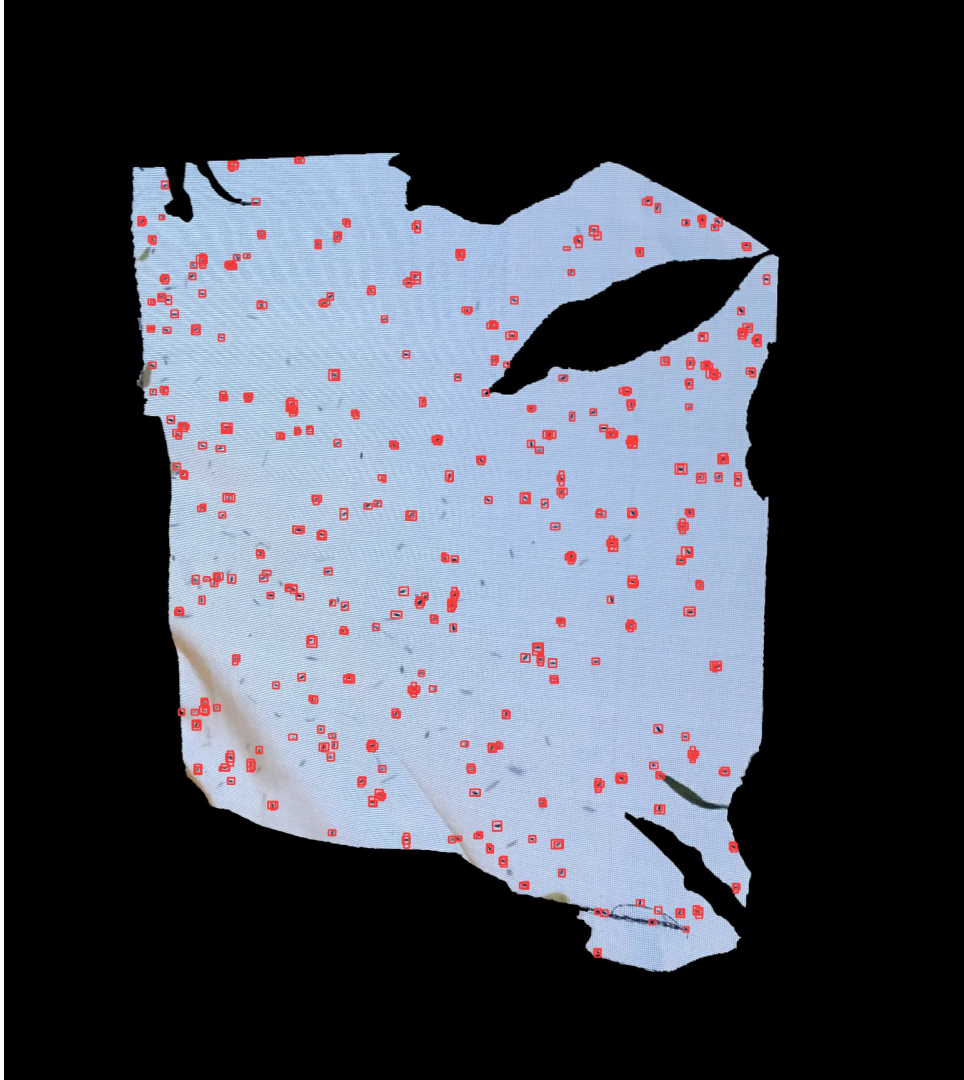


Why didn’t I start with deep learning?

I. Not sure if I had the data or computational power

II. Didn’t think the task was complex enough

III. Wanted to explore and learn about previous approaches

Previous Methods

I. ImageJ (Image Processing)

II. Threshold (Image Processing)

III. Contour detection (Image Processing)

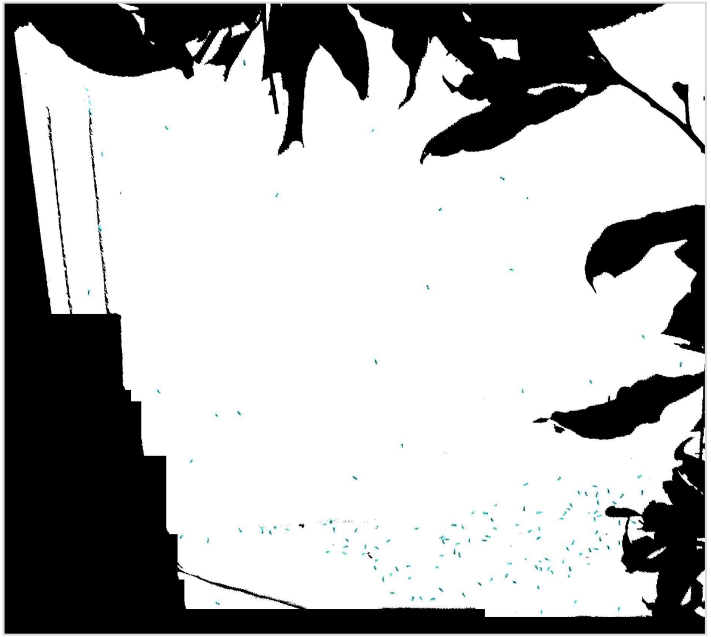
IV. Haar Cascade Classifier (Machine Learning)

Method #1: ImageJ (Image Processing)

1. Grayscale
2. Threshold (Black & White)*
3. Count particles*

** Manual parameter adjustment*

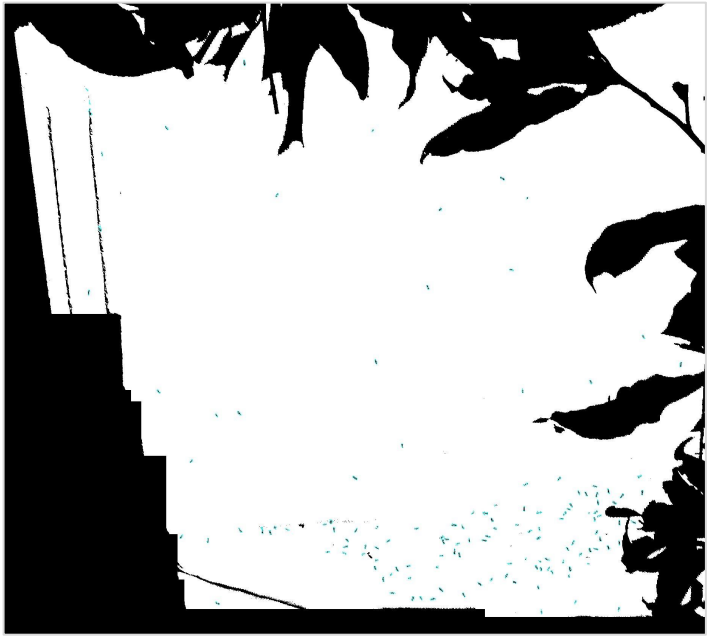
Pretty accurate!



Method #2: Threshold (Image Processing)

1. Grayscale
2. Threshold (Black & White)
3. Count particles

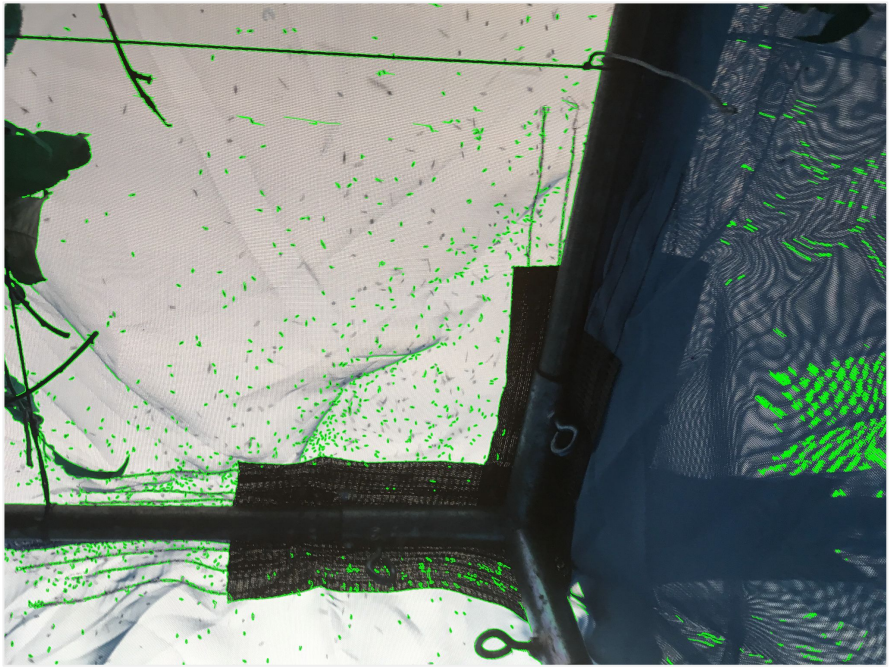
Accuracy not as great,
No manual parameter adjustment



Method #3: Contour Detection

1. Grayscale
2. Blur
3. Detect edges
4. Detect contours (closed edges)

**Accuracy not too great,
Many false positives
(too many contours)**



Method #4: Haar Cascade Classifier (Machine Learning)

1. Draw bounding boxes around flies from 9 photos (positive examples)
2. Create images without flies by cropping (negative examples)
3. Give positive and negative examples to machine to learn

Accuracy not that great, Many false positives and difficulty detecting high density areas

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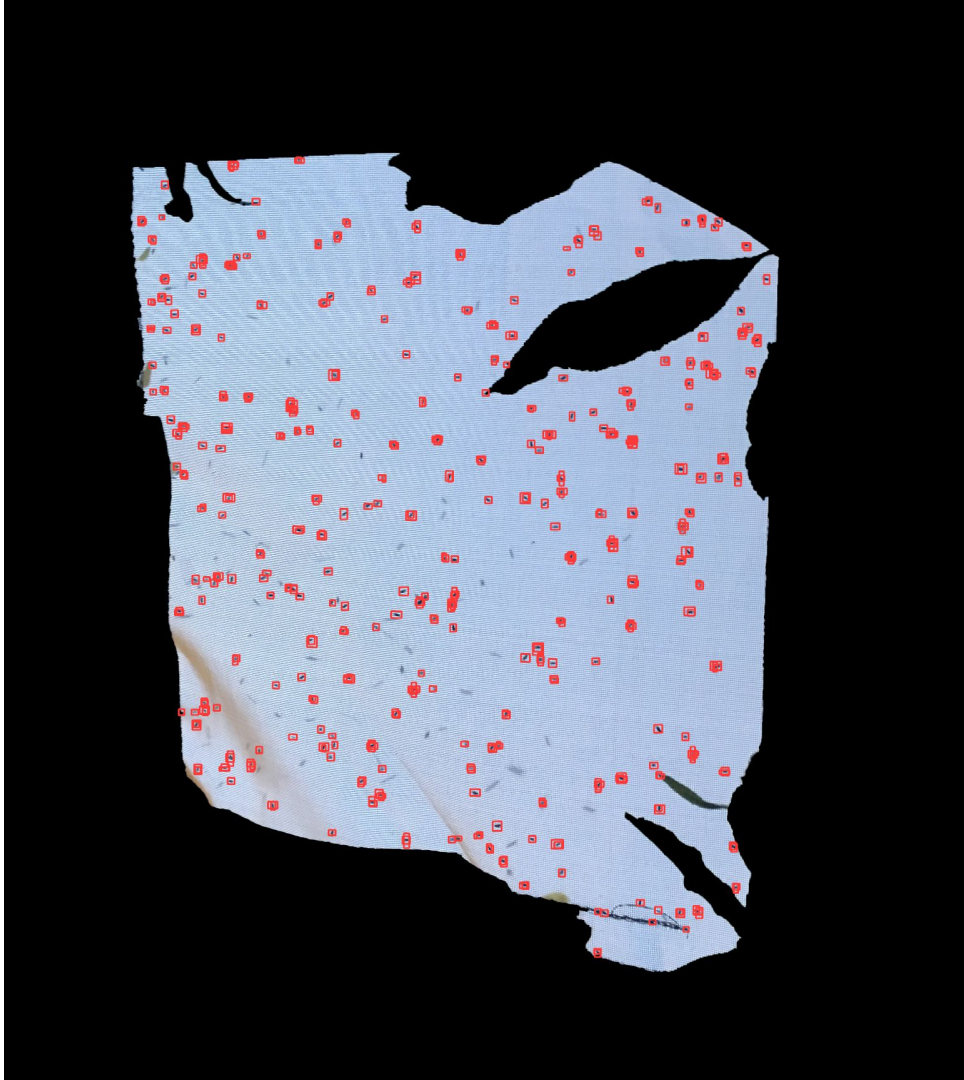


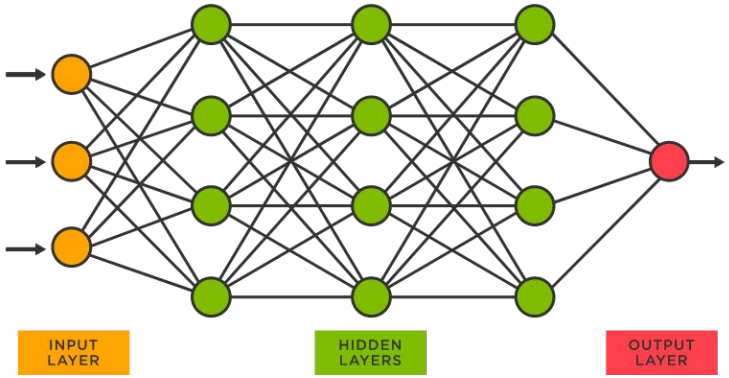
Why use deep learning now then?

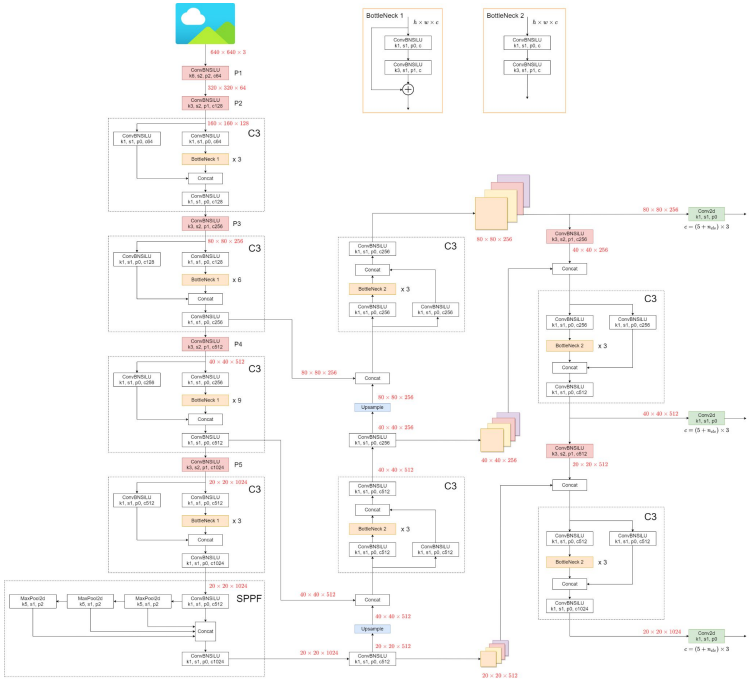
I. State-of-the-art, what is being used by everyone in research and industry

II. A bunch of existing libraries, frameworks, and documentation

III. Better accuracy

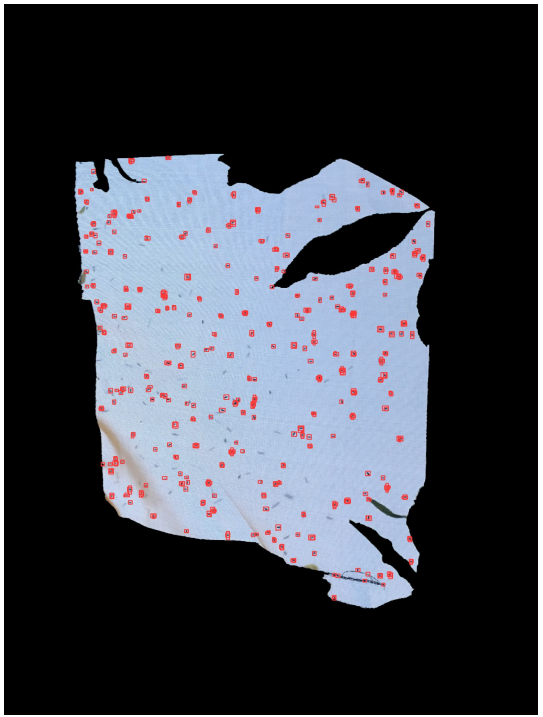
YOLOv5 for Object Detection



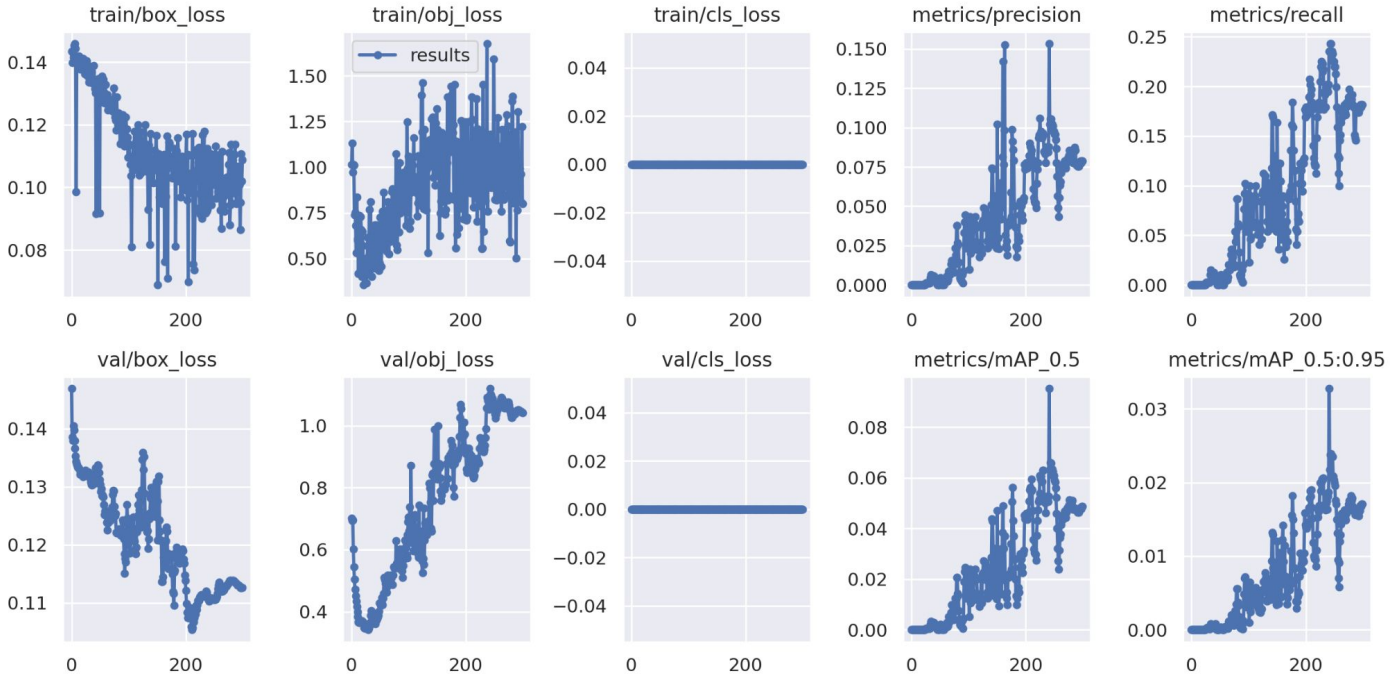


Training the model (6 training images)

Model results



Model results



Model results analysis

Via metrics

1. Very low mAP, I have very low precision (There are few true positives and/or a lot of false positives)
2. Increasing object loss

Via visual inspection:

1. Unable to detect clustered flies
2. Repeated detection of single flies

Future directions

1. Start counting flies using ImageJ as a backup
2. Continue tweaking the model
3. Reach out Shamreen for advice