College of Electrical & Mechanical Engineering
Department of C&SE

Course:

EC312 Digital Image Processing

Project:

Automated Detection & Segmentation of Threat Items in Luggage

Group members

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Submitted to:

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Description

1. Data Cleaning

- The given dataset contained images categorized into three classes, but the images had objects of two or more classes.
- To mitigate the issue mentioned above a CSV file was created and maintained by Irtaza. The CSV had filenames and respective One-Hot encodings.

2. Code

- Code at notebook: https://colab.research.google.com/drive/1TajC2gIS-ZVHRVT08O54UmVBpRHfgVHE?usp=sharing
- Models and Intermediate outputs: https://drive.google.com/drive/u/1/folders/1ioYvlDXJOs92WVDthEsFYyh-T7w993rF

3. Classification

- A OneVsRestClassifier with an SVM-HOG approach was tried by Abdullah to classify objects in the image and highlight them by some bounding box. However, the implementation didn't work mainly because the data had extreme cases of rotation and overlaps.
- In parallel, another classifier based on a convolutional neural network (CNN) was developed by Taimoor. This classifier returns a tuple following One-Hot encoding. If the images contained a gun or a knife or have instances of either both or none, CNN will output accordingly.
- The output of CNN is then used to make two confusion matrices, one for 'gun' class and the other for 'knife' class, to see its effectiveness.

4. Confusion Matrices

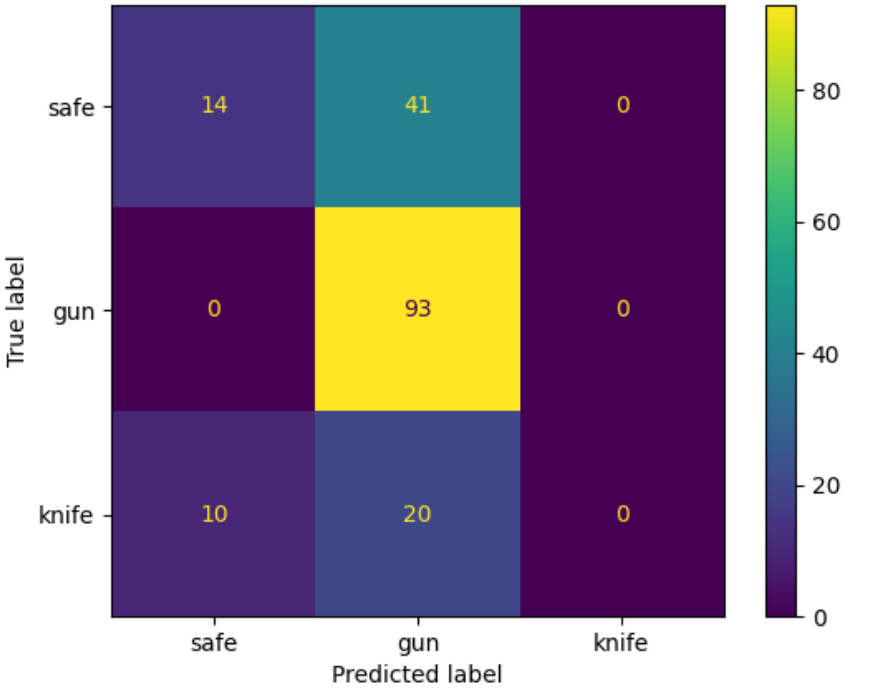


Figure 1: Confusion matrix for SVM-HOG

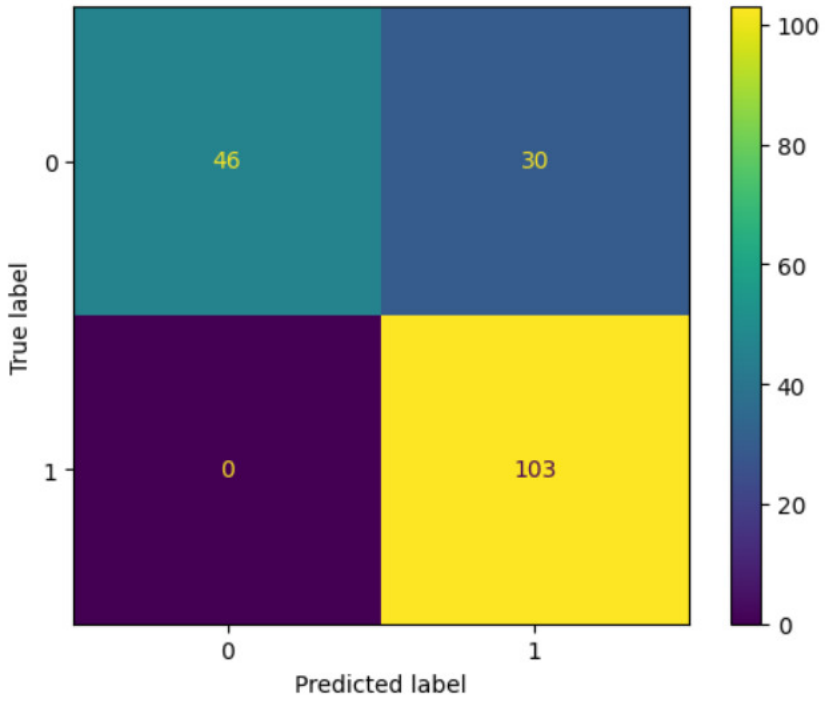


Figure 2: Confusion matrix for 'gun' class

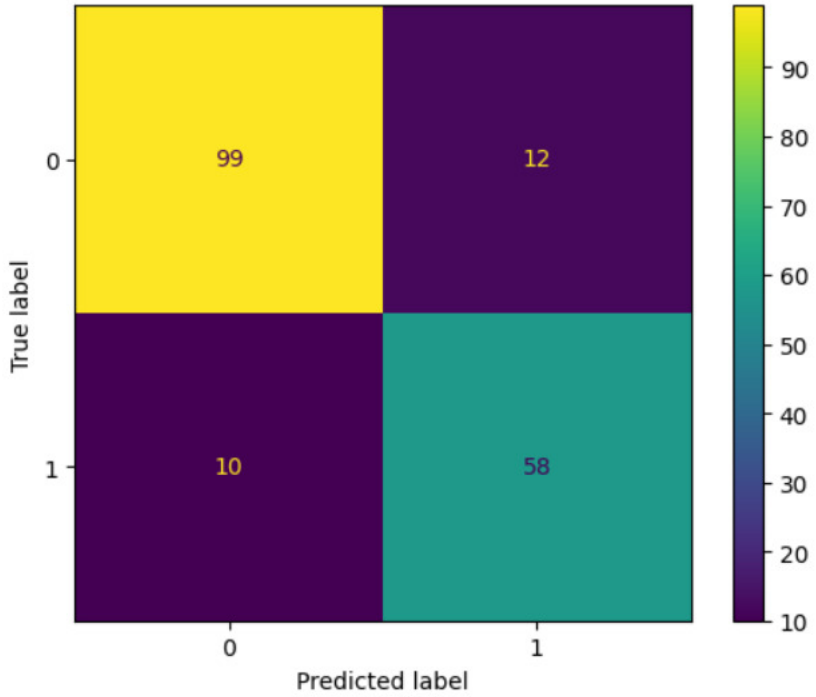


Figure 3: Confusion matrix for 'knife' class

5. Segmentation

- Segmentation was done using U-Net by Irtaza and Taimoor. Initially, they approached the problem with two different U-Nets being trained, one for the classification of ‘gun’ class and the other for the classification of ‘knife’ class.
- Later, a single U-Net for the segmentation of images was preferred.
- The following input data was given to the U-Net:
  - *Contours*: Due to rescaling images the contours were erased so we didn’t take this approach.
  - *Binary threshold image*: The model learned the threshold masks, and it was receiving sufficient accuracy by just coloring the mask and separating it from the background.
  - *Segmented Images*: This is the current approach. In this approach, a bitwise_xor function is called on the masks and edges, which helps in separating overlapping objects. This new mask is applied to the enhanced original image, generating an output having a background as black and retaining the original threats.
- The U-Net works in the following way:

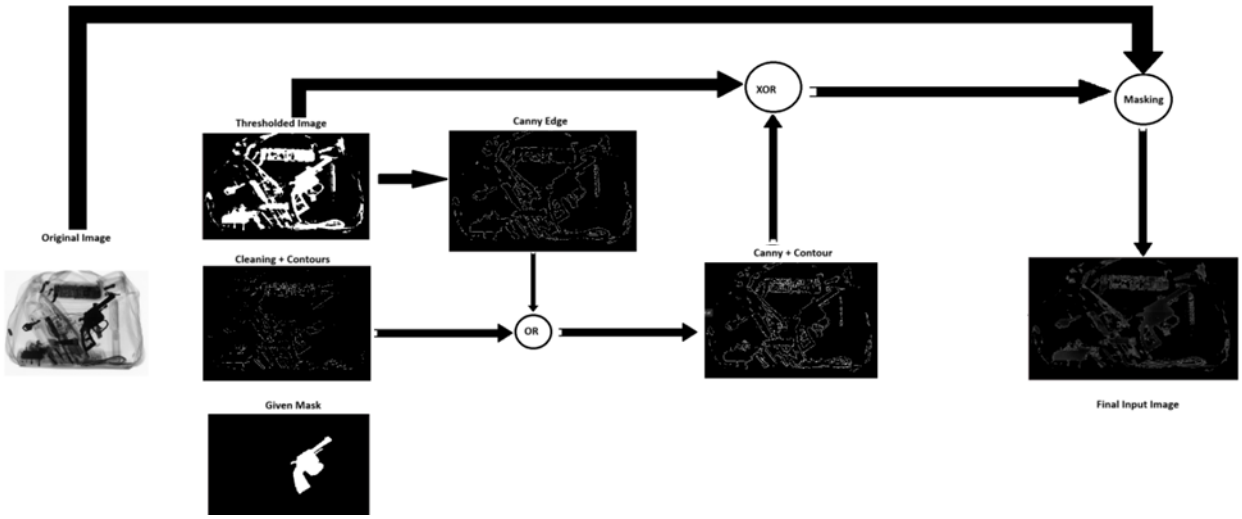


Figure 4: Segmentation workflow

Flow Diagrams

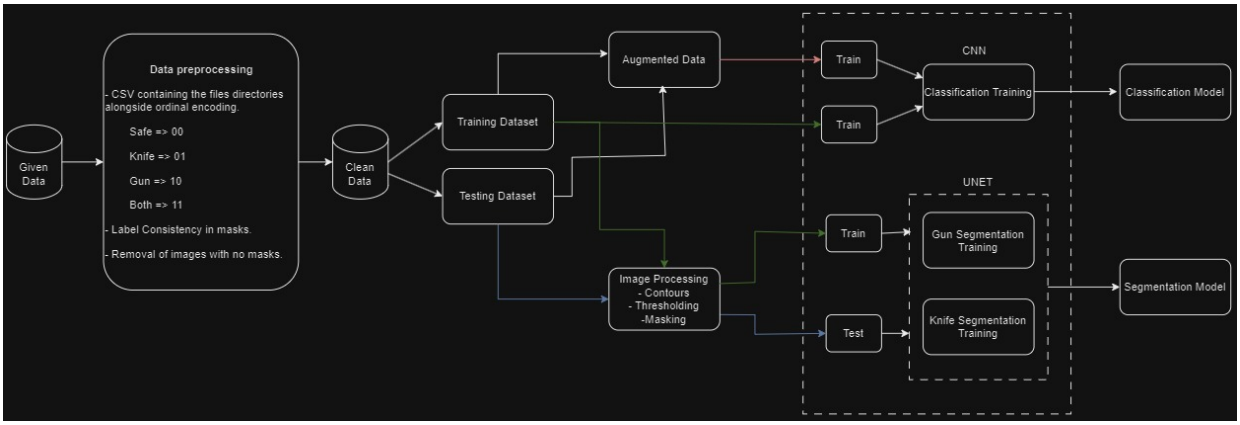


Figure 5: Old approach for Segmentation

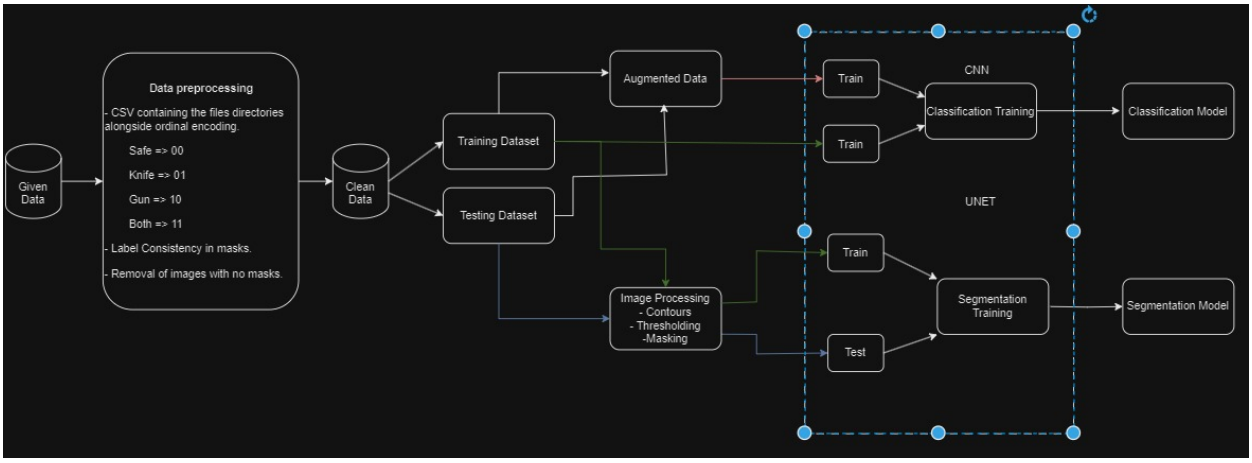
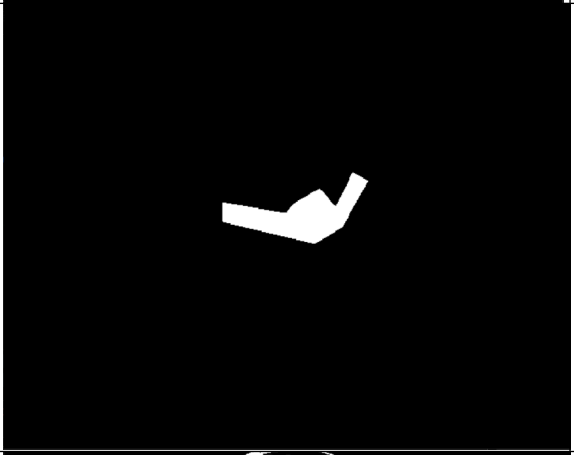
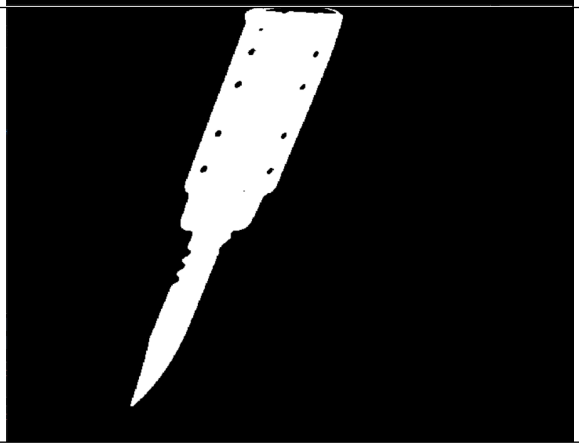
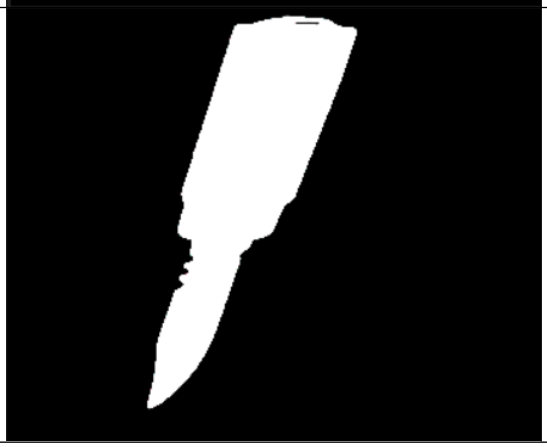


Figure 6: New approach for Segmentation

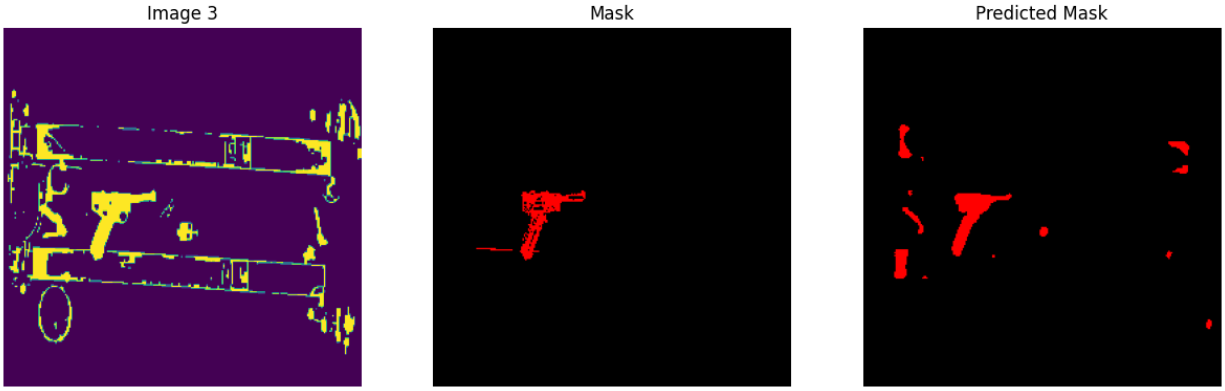
Sample Outputs

Taimoor's CNN Model:

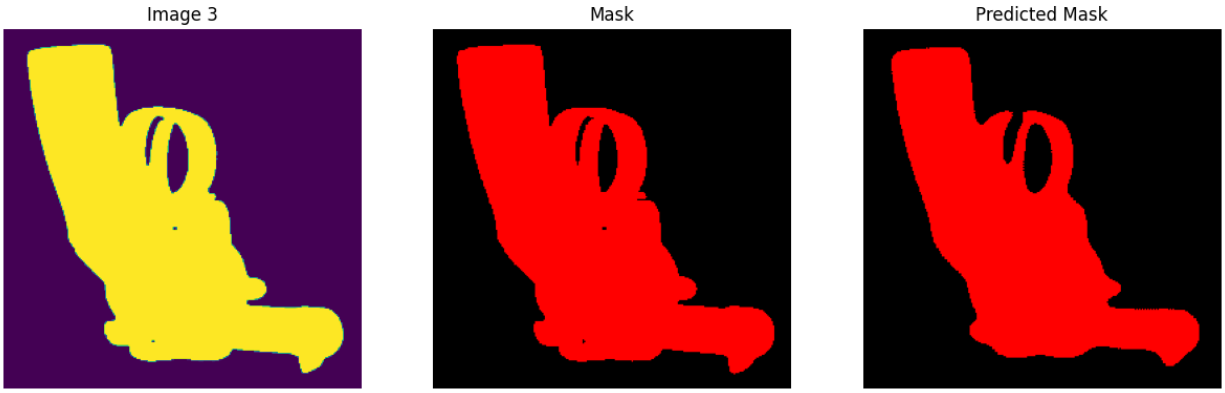
Filename	Given Mask	Generated Mask	Dice Coeff
B0046_0002.png			0.29
P02085.png			0.59
P01899.png			0.24
B0008_0003.png			0.60

Irtaza’s U-Net Model

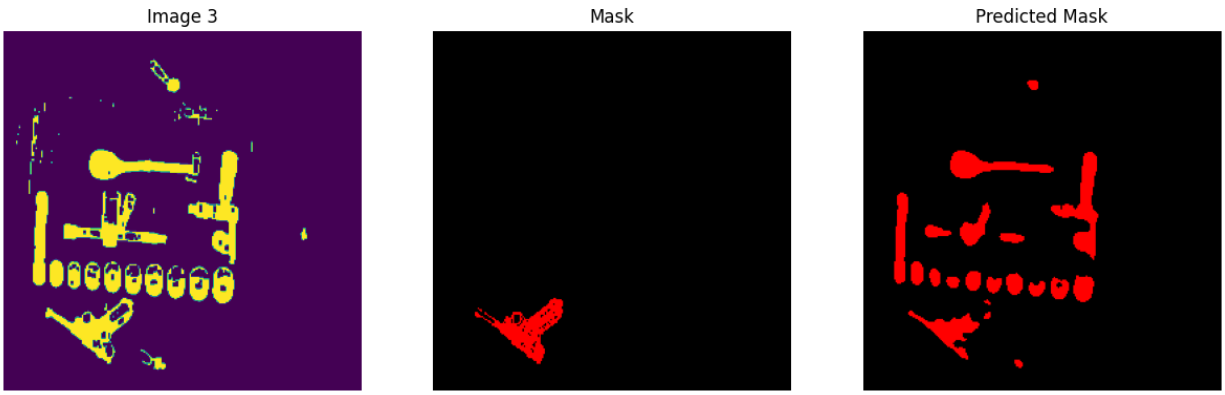
Epoch 13



Epoch 10



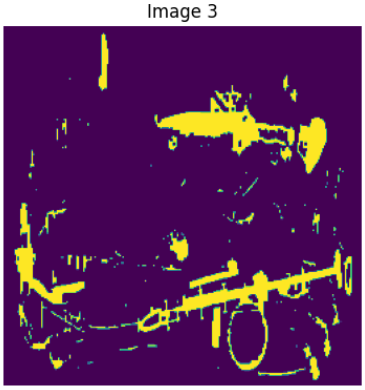
Epoch 12



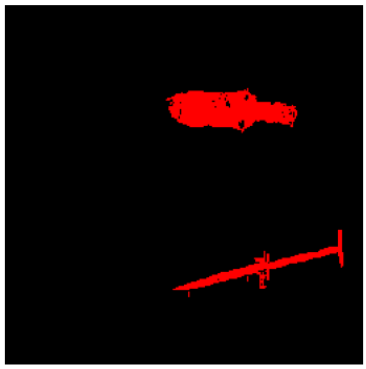
Epoch 8

Epoch 14

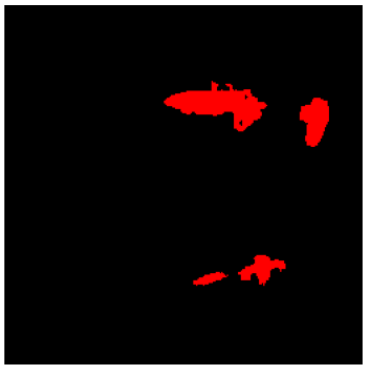
Image 3



Mask

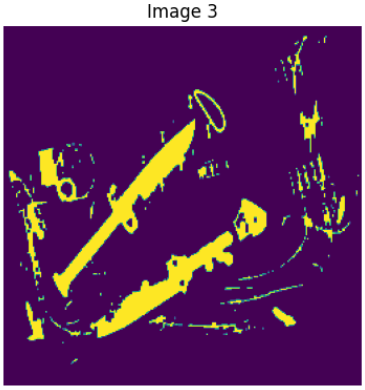


Predicted Mask



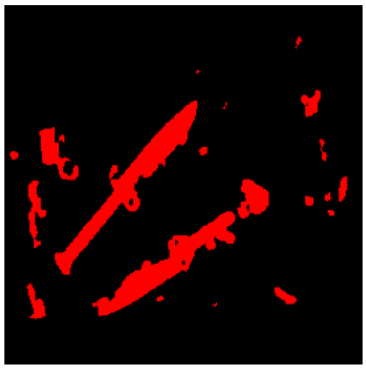
Epoch 13

Image 3



Mask

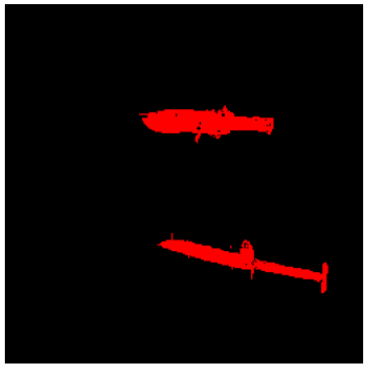
Predicted Mask



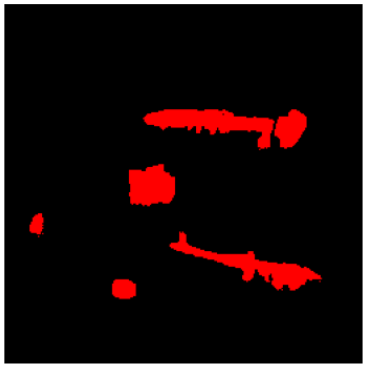
Epoch 12

Image 3

Mask



Predicted Mask



Epoch 2

Image 3

Mask

Predicted Mask