# Lecture 10:

## Convolutional Neural Networks (CNN) – Part II

Markus Hohle

University California, Berkeley

**Machine Learning Algorithms**

MSSE 277B, 3 Units

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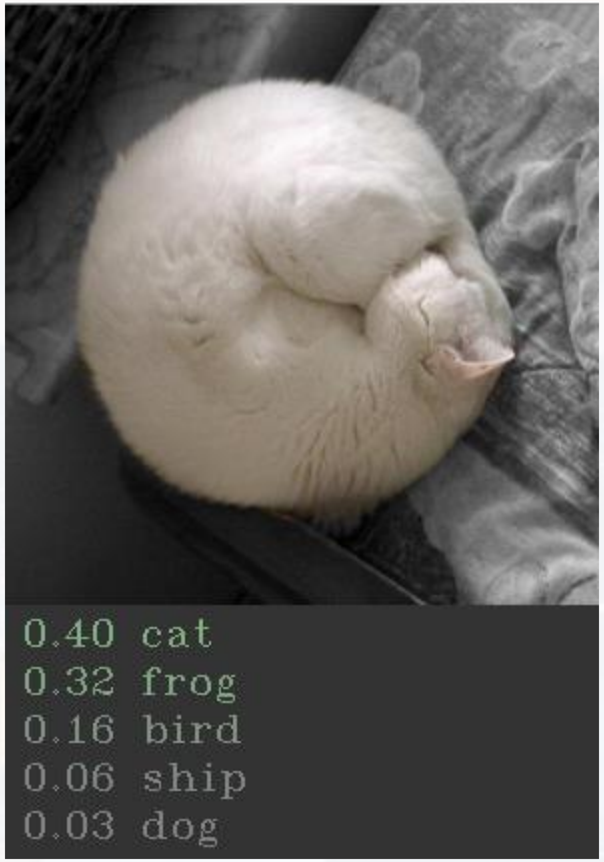
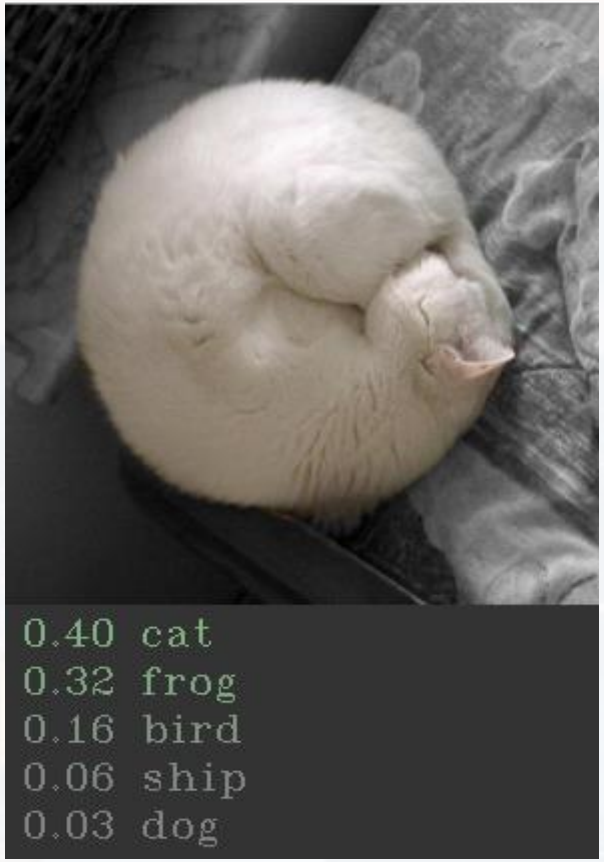



## Outline

- **Labeling Tools**
- **Calling a Pretrained CNN**


## Outline

- **Labeling Tools**

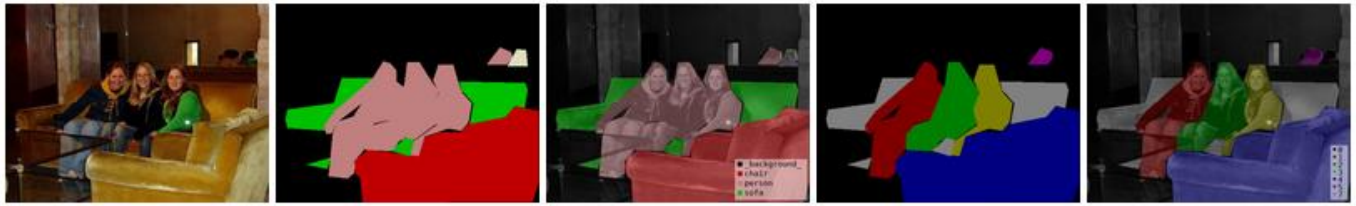
- **Calling a Pretrained CNN**

# Convolutional Neural Networks: Labeling

[“labelme”]

## Description

Labelme is a graphical image annotation tool inspired by http://labelme.csail.mit.edu.
It is written in Python and uses Qt for its graphical interface.

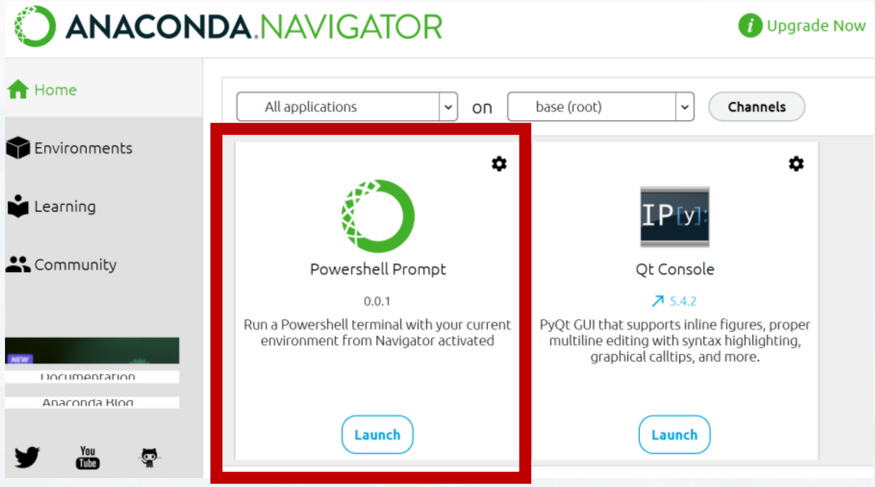


*VOC dataset example of instance segmentation.*

*Other examples (semantic segmentation, bbox detection, and classification).*

*Various primitives (polygon, rectangle, circle, line, and point).*

# Convolutional Neural Networks: Labeling




```
conda install labelme
```

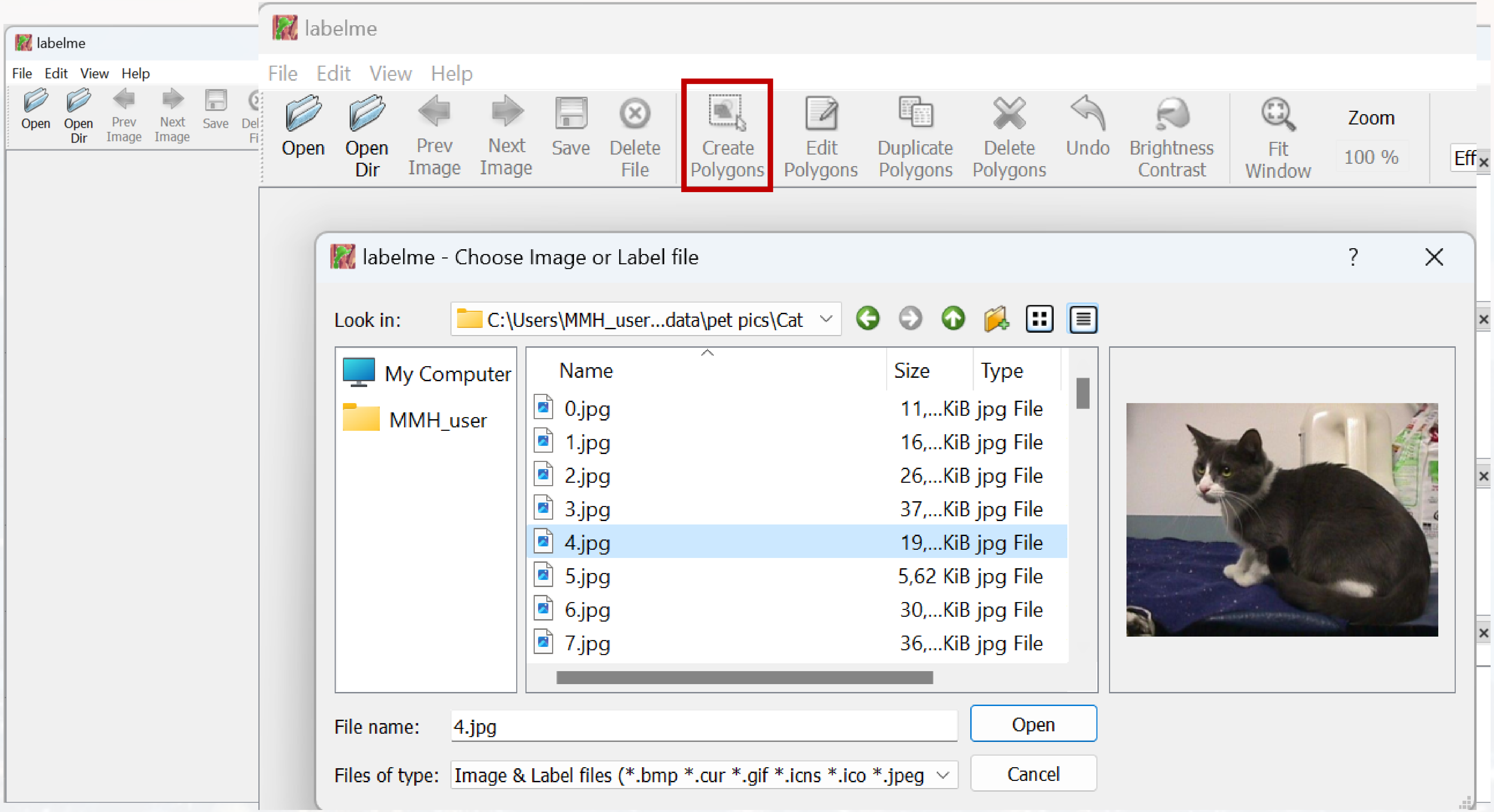
C:\WINDOWS\System32\Win

```
(base) PS C:\Users\MMH_user> conda create --name=labelme python=3
```

```
(base) PS C:\Users\MMH_user> conda activate labelme
```

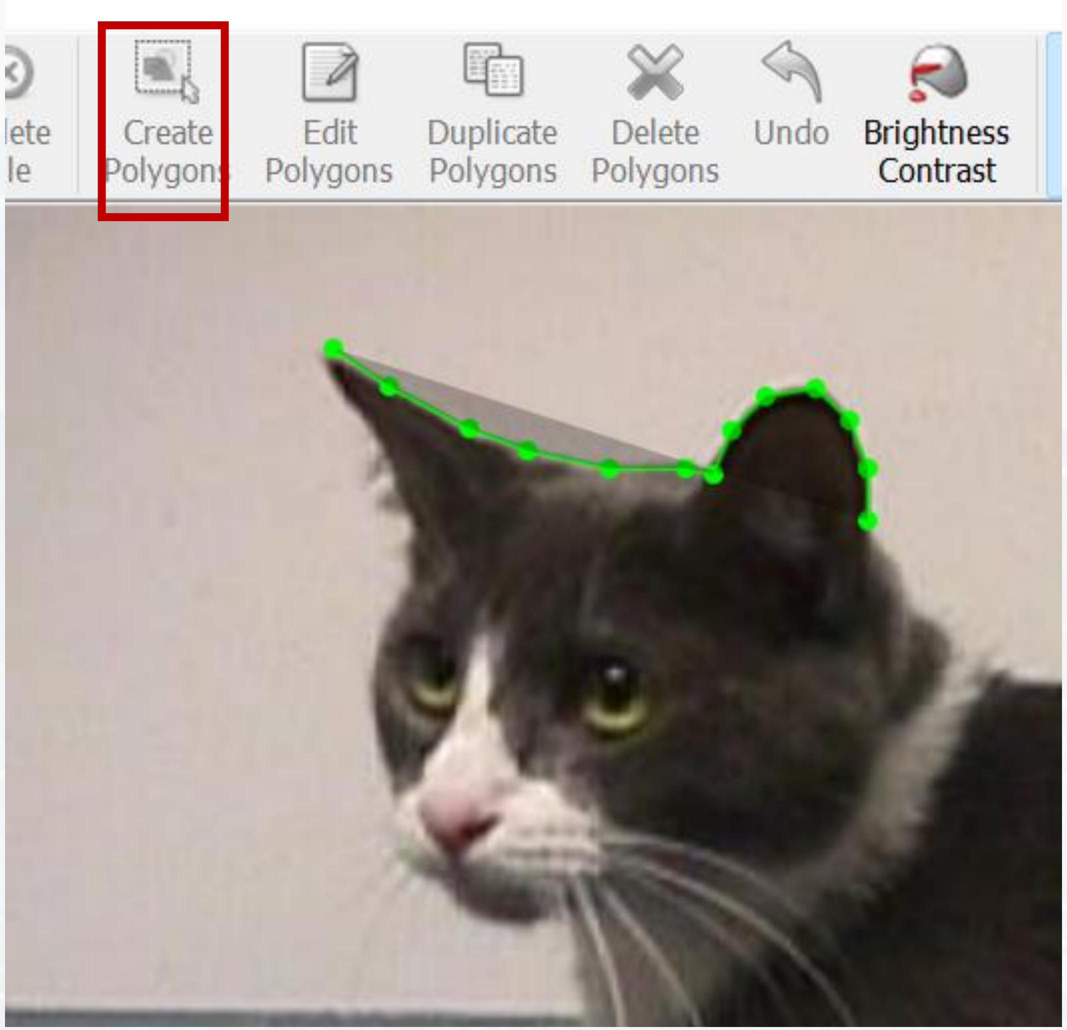
```
(labelme) PS C:\Users\MMH_user> labelme
```

# Convolutional Neural Networks:

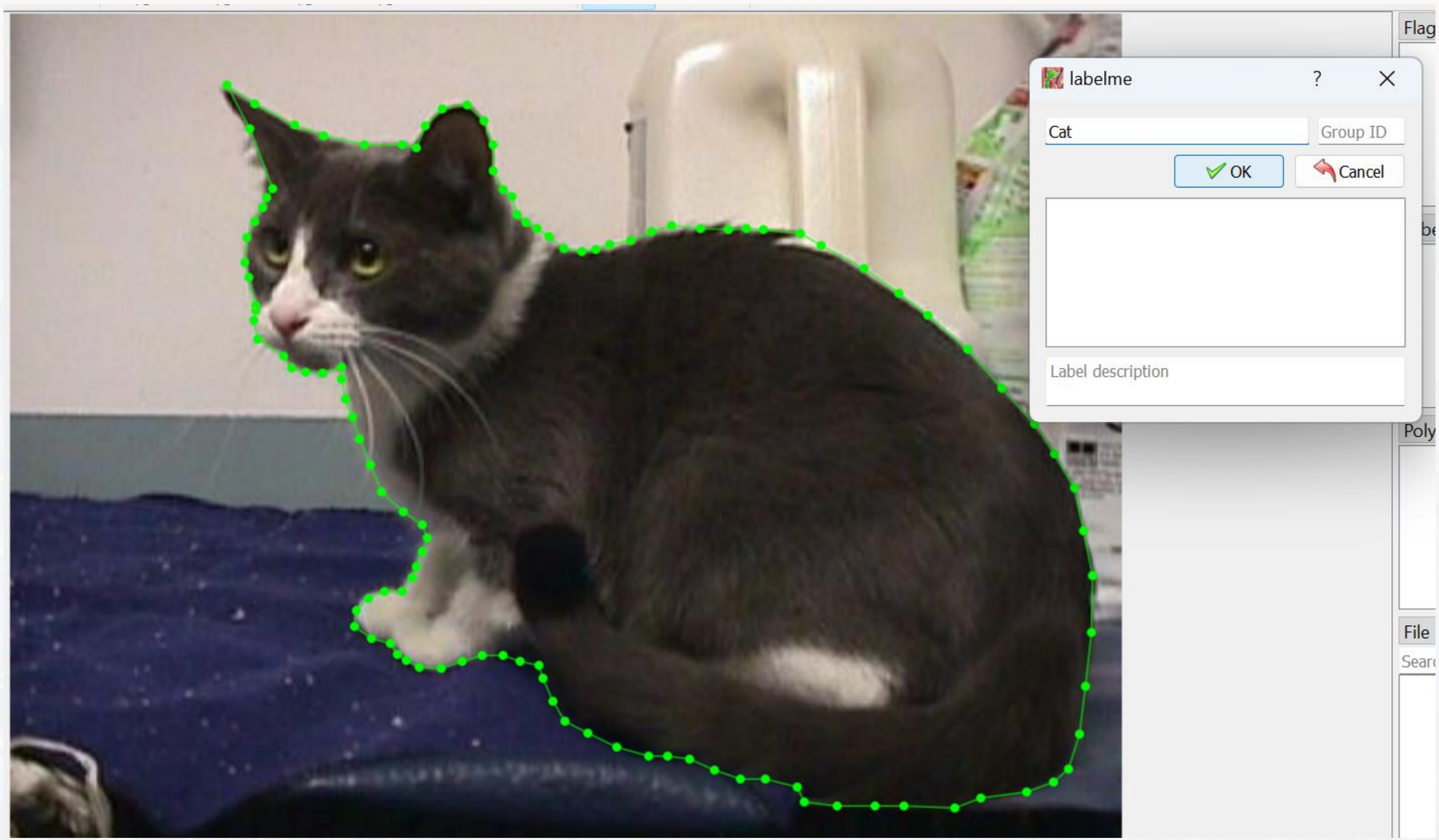


# Convolutional Neural Networks:





# Convolutional Neural Networks: Labeling



# Convolutional Neural Networks: Labeling

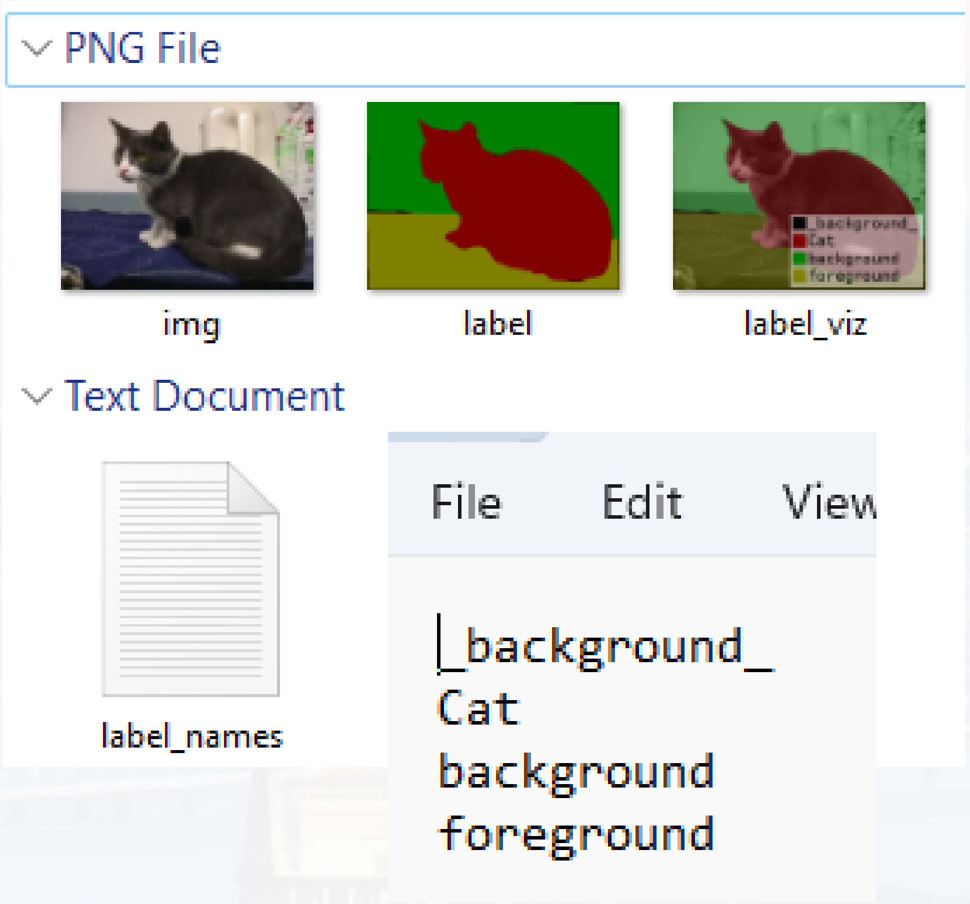
# Convolutional Neural Networks: Labeling

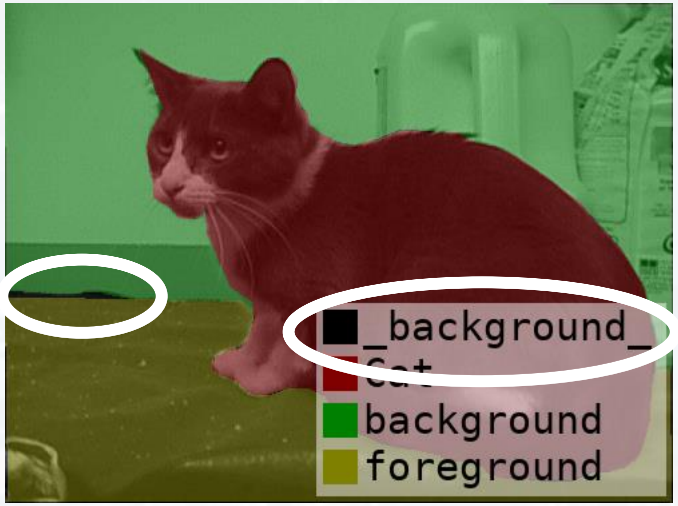
image is saved as `.json`


run within the labelme prompt:

```
labelme_export_json .\Cat4label.json -o Cat4label_json
```

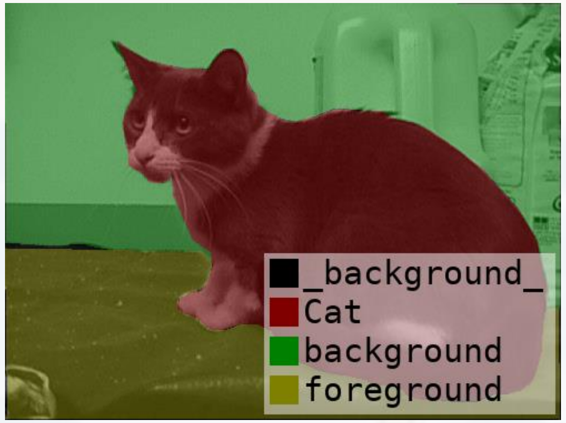
# Convolutional Neural Networks: Labeling



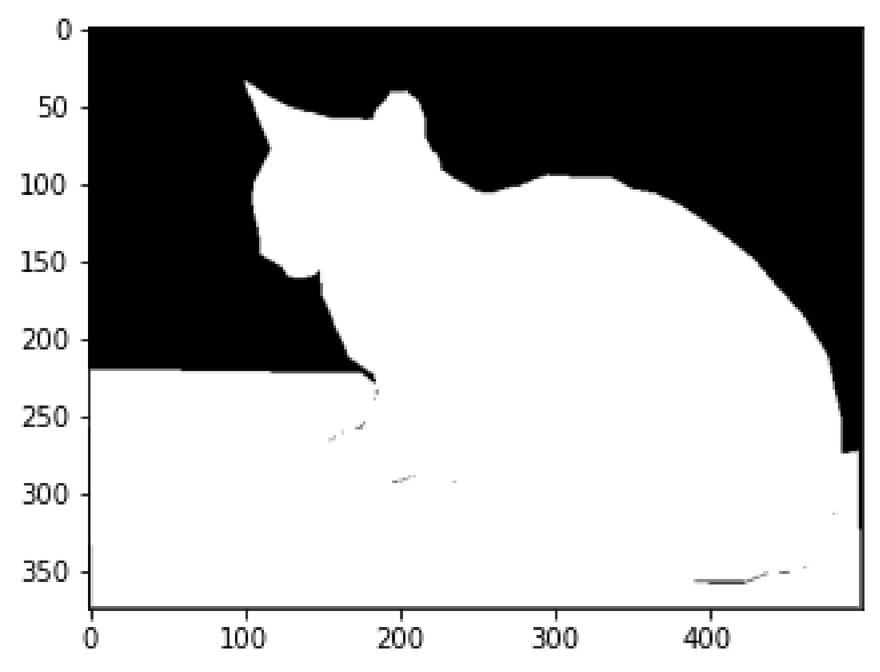



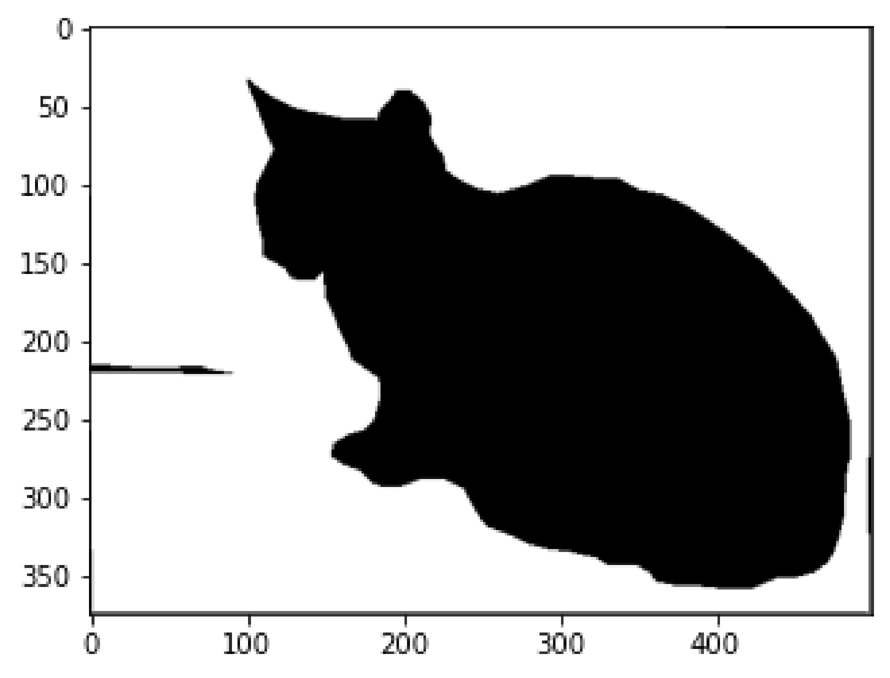
# Convolutional Neural Networks:



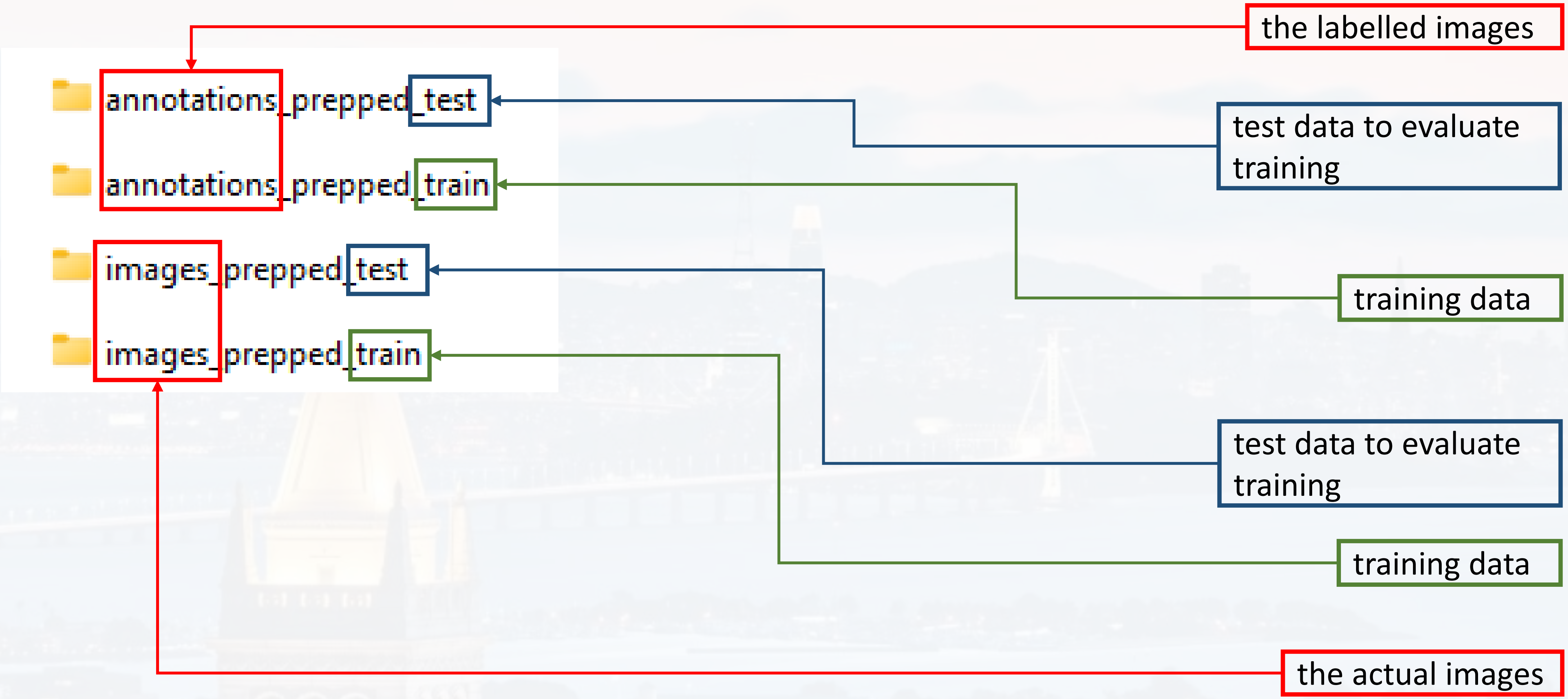



```
I = plt.imread('Cat/Cat4label_json/label.png')
I.shape
(375, 500, 4)
```



# Convolutional Neural Networks:

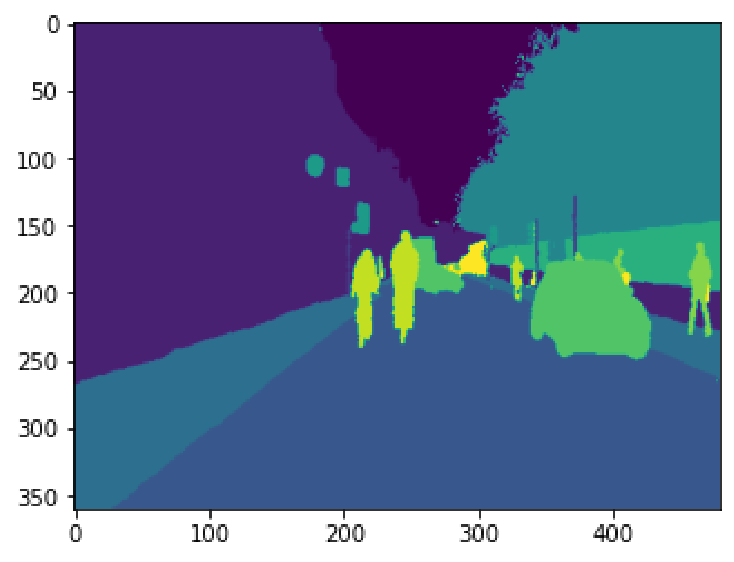


# Convolutional Neural Networks:



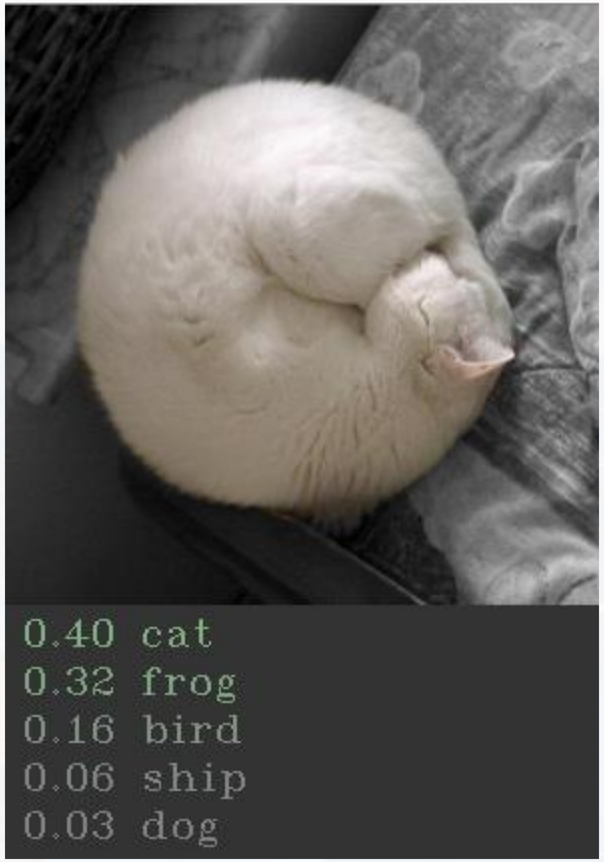
[nice dataset]

**images**_prepped_test




**annotations**_prepped_test

```
I = plt.imread('segmentation/pics/annotations_prepped_test/0016E5_07959.png')
I.shape
(360, 480)
```


## Outline

- Labeling Tools

- **Calling a Pretrained CNN**

demonstrating realistic segmentation with reasonable results will take a few hours

→ check out my code on GitHub

# Convolutional Neural Networks: Segmentation

```
from keras_segmentation.models.unet import *
```

| Type | Names |
|---|---|
| VGG | 'vgg16' 'vgg19' |
| ResNet | 'resnet18' 'resnet34' 'resnet50' 'resnet101' 'resnet152' |
| SE-ResNet | 'seresnet18' 'seresnet34' 'seresnet50' 'seresnet101' 'seresnet152' |
| ResNeXt | 'resnext50' 'resnext101' |
| SE-ResNeXt | 'seresnext50' 'seresnext101' |
| SENet154 | 'senet154' |
| DenseNet | 'densenet121' 'densenet169' 'densenet201' |
| Inception | 'inceptionv3' 'inceptionresnetv2' |
| MobileNet | 'mobilenet' 'mobilenetv2' |
| EfficientNet | 'efficientnetb0' 'efficientnetb1' 'efficientnetb2' 'efficientnetb3' 'efficientnetb4' 'efficientnetb5' efficientnetb6' efficientnetb7' |

```
model = vgg_unet(n_classes = n_classes,\
                         input_height = 416, input_width = 608)

model.train(
       train_images        = my_path + r"images_prepped_train//",
       train_annotations = my_path + r"annotations_prepped_train//",
       checkpoints_path   = my_path + r"checkpoints//",
       do_augment                    = True,
       gen_use_multiprocessing = True,
       auto_resume_checkpoint  = True,
       epochs  = 5)
```

calling the specific net-work

saves current weights

Keras provides an augmentation routine

# Convolutional Neural Networks:



```
model = vgg_unet(n_classes = n_classes,\
                            input_height = 416, input_width = 608)

model.train(
        train_images       = my_path + r"images_prepped_train//",
        train_annotations = my_path + r"annotations_prepped_train//",
        checkpoints_path  = my_path + r"checkpoints//",
        do_augment                  = True,
        gen_use_multiprocessing = True,
        auto_resume_checkpoint  = True,
        epochs = 5)
```

Keras provides an augmentation routine

Note: I always run my **own augmentation** routine, see e.g. `AugmentMyImages.py`

run:

```
S = SegmentMyImages()

S.Training()
```

# Convolutional Neural Networks: Segmentation

```
S = SegmentMyImages()

S.Training()
```

```
Dataset verified!
Epoch 1/5
512/512 [==============================] - ETA: 0s - loss: 4.1406 - accuracy: 0.0353     saved  ../data/segmentation
pics/checkpoints//.0
512/512 [==============================] - 3888s 8s/step - loss: 4.1406 - accuracy: 0.0353
Epoch 2/5
512/512 [==============================] - ETA: 0s - loss: 3.7805 - accuracy: 0.1636     saved  ../data/segmentation
pics/checkpoints//.1
512/512 [==============================] - 4133s 8s/step - loss: 3.7805 - accuracy: 0.1636
Epoch 3/5
512/512 [==============================] - ETA: 0s - loss: 3.4534 - accuracy: 0.3338     saved  ../data/segmentation
pics/checkpoints//.2
512/512 [==============================] - 4072s 8s/step - loss: 3.4534 - accuracy: 0.3338
Epoch 4/5
512/512 [==============================] - ETA: 0s - loss: 3.1926 - accuracy: 0.3980     saved  ../data/segmentation
pics/checkpoints//.3
512/512 [==============================] - 3363s 7s/step - loss: 3.1926 - accuracy: 0.3980
Epoch 5/5
512/512 [==============================] - ETA: 0s - loss: 3.0071 - accuracy: 0.4318   saved  ../data/segmentation
pics/checkpoints//.4
512/512 [==============================] - 3616s 7s/step - loss: 3.0071 - accuracy: 0.4318
```

# Convolutional Neural Networks: Segmentation

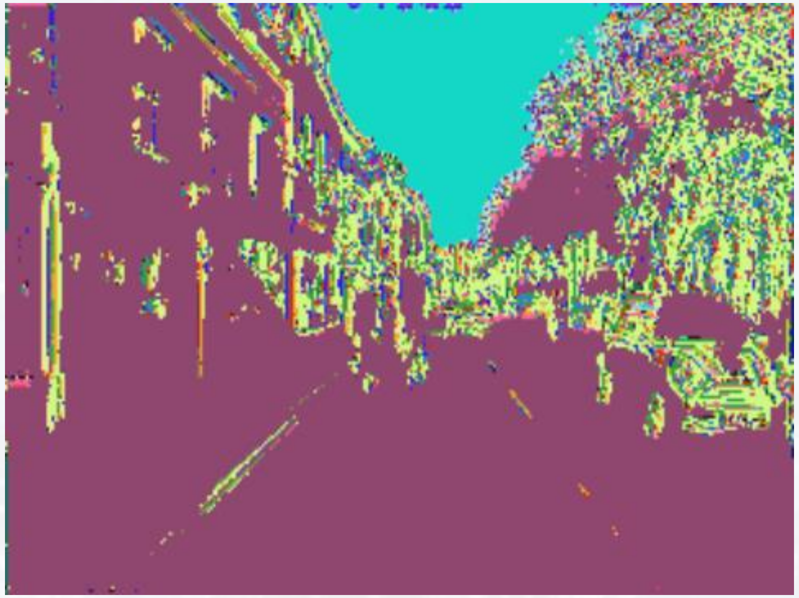
```
MyModel = S.TrainedModel
```

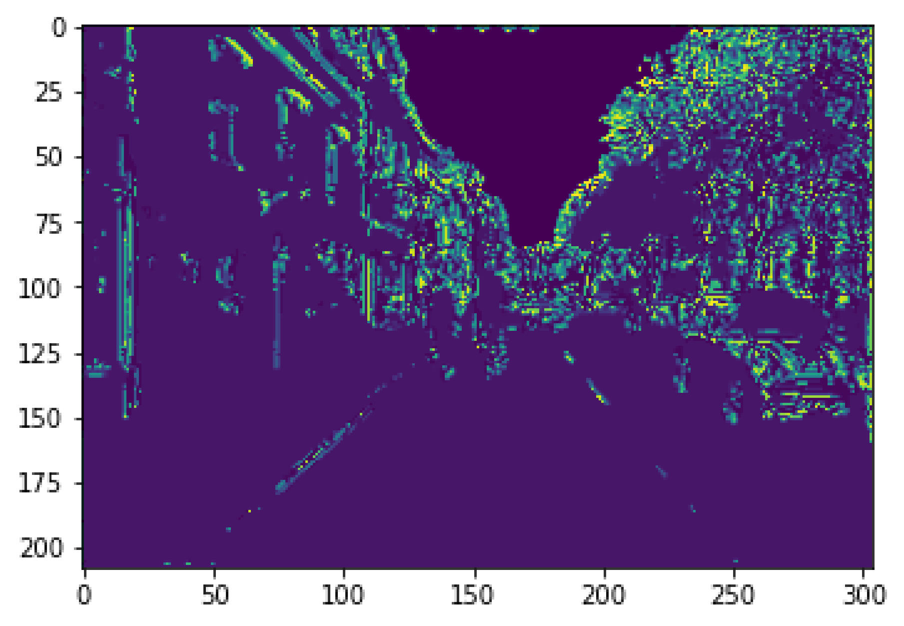
```
MyModel.summary()
```
→ returns the structure of the CNN

**applying** the trained CNN to an image:

```
out = S.ApplyTrainedNetwork()
```

```
plt.imshow(out)
```





# Convolutional Neural Networks: Segmentation

<u>recovering model from checkpoints:</u>

```
MyModel  = S.TrainedModel
out      = S.ApplyTrainedNetwork()
```

**applying** the trained CNN to an image:

```
S.RecoverFromCheckpoint()
```

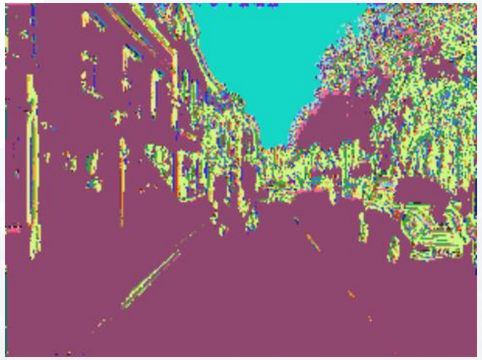
untrained model (just CNN itself)

```
#loading untrained CNN
model = self.model

if not image_name:
    image_name = '0016E5_07965.png'

#calling input from checkpoints
latest = tf.train.latest_checkpoint(self.checkpoint_path)
model.load_weights(latest)
```

transfer the saved weights to untrained network → now it starts from latest training state



# Convolutional Neural Networks: Segmentation

visualizing weights:

→ see `model.layers`

nice example

**Thank you very much for your attention!**