

Utilization of Mask-RCNN implementation by Matterport

[https://github.com/matterport/Mask\\_RCNN](https://github.com/matterport/Mask_RCNN)

Manage Imports

```
In [1]: import os
import sys
import random
import math
import re
import time
import numpy as np
import cv2
import matplotlib
import matplotlib.pyplot as plt
import json
import skimage
```

Setup Mask-RCNN configuration variables

```
In [2]: PROJ_ROOT_DIR = os.getcwd()
MASK_ROOT = os.path.join(PROJ_ROOT_DIR, "Mask_RCNN")
COCO_MODEL_DIR = os.path.join(MASK_ROOT, "mask_rcnn_coco.h5")
MODEL_CHECKPOINT_DIR = os.path.join(PROJ_ROOT_DIR, "models")
DEFAULT_LOGS_DIR = MODEL_CHECKPOINT_DIR
sys.path.append(PROJ_ROOT_DIR)
sys.path.append(MASK_ROOT)
```

Import the Mask-RCNN implementation module

```
In [3]: from mrcnn.config import Config
from mrcnn import utils
import mrcnn.model as modellib
from mrcnn import visualize
from mrcnn.model import log
```

Using TensorFlow backend.

Setup Mask-RCNN dataset class

```
In [4]: class BuoyConfig(Config):
    NAME = "bouy"

    IMAGE_RESIZE_MODE="square"
    IMAGE_MIN_DIM=128
    IMAGE_MAX_DIM=256
    GPU_COUNT = 1
    IMAGES_PER_GPU = 1

    NUM_CLASSES = 2
    STEPS_PER_EPOCH = 500

    class BuoyDataset(utils.Dataset):

        def compose_im(self, x, sort_files, annotations_dir, im_dir):
            anno = json.load(open(annotations_dir+sort_files[x]))
```

```

impath = os.path.join(im_dir, os.path.splitext(sort_files[x])[0])
sz = anno["size"]
pts = []
for obj in anno["objects"]:
    if obj["classTitle"] == 'buoy':
        pts.append(obj["points"]["exterior"])
self.add_image(
    "buoy",
    image_id=os.path.splitext(sort_files[x])[0],
    path=impath,
    width=sz["width"],
    height=sz["height"],
    polygons=pts
)

def load_buoys(self, stage="train"):
    self.add_class("buoy", 1, "buoy")
    annotations_dir = os.path.join(os.getcwd(), "buoy_data/Train/ann/")
    im_dir = os.path.join(os.getcwd(), "buoy_data/Train/img/")
    file_lst = os.listdir(path=annotations_dir)
    sort_files = sorted(file_lst)
    file_len = len(sort_files)
    train_count = int(file_len*.7)
    val_count = int(file_len*.3)
    if stage == 'train':
        for x in range(train_count):
            self.compose_im(x, sort_files, annotations_dir, im_dir)

    else:
        for x in range(val_count):
            self.compose_im(x+train_count, sort_files, annotations_dir, im_dir)

def load_mask(self, image_id):
    image_info = self.image_info[image_id]
    if image_info["source"] != "buoy":
        return super(self.__class__, self).load_mask(image_id)

    # Convert polygons to a bitmap mask of shape
    # [height, width, instance_count]
    info = self.image_info[image_id]
    mask = np.zeros([info["height"], info["width"], len(info["polygons"])],
                    dtype=np.uint8)

    all_x = []
    all_y = []
    for i, p in enumerate(info["polygons"]):
        # Get indexes of pixels inside the polygon and set them to 1
        for pt in p:
            all_x.append(pt[0])
            all_y.append(pt[1])
        rr, cc = skimage.draw.polygon(all_y, all_x)
        mask[rr-1, cc-1, i] = 1
    all_x = []
    all_y = []

    # Return mask, and array of class IDs of each instance. Since we have
    # one class ID only, we return an array of 1s
    return mask.astype(np.bool), np.ones([mask.shape[-1]], dtype=np.int32)

```

```
def image_reference(self, image_id):
    info = self.image_info[image_id]
    if info["source"] == "buoy":
        return info["path"]
    else:
        super(self.__class__, self).image_reference(image_id)
```

## Create Model and Fetch COCO weights

In [5]: `utils.download_trained_weights(COCO_MODEL_DIR)`

Downloading pretrained model to c:\CV-Proj\Mask\_RCNN\mask\_rcnn\_coco.h5 ...  
... done downloading pretrained model!

In [5]: `model = modellib.MaskRCNN(mode='training', config=BuoyConfig(), model_dir=MODEL_CHECKPOINT_DIR,
model.load_weights(COCO_MODEL_DIR, by_name=True,
 exclude=["mrcnn_class_logits", "mrcnn_bbox_fc",
 "mrcnn_bbox", "mrcnn_mask"])

# in case training gets interrupted, have ability to start from last save point
# model.load_weights(model.find_last(), by_name=True)`

WARNING:tensorflow:From c:\CV-Proj\venv\lib\site-packages\keras\backend\tensorflow\_backend.py:504: The name tf.placeholder is deprecated. Please use tf.compat.v1.placeholder instead.

WARNING:tensorflow:From c:\CV-Proj\venv\lib\site-packages\keras\backend\tensorflow\_backend.py:68: The name tf.get\_default\_graph is deprecated. Please use tf.compat.v1.get\_default\_graph instead.

WARNING:tensorflow:From c:\CV-Proj\venv\lib\site-packages\keras\backend\tensorflow\_backend.py:3828: The name tf.random\_uniform is deprecated. Please use tf.random.uniform instead.

WARNING:tensorflow:From c:\CV-Proj\venv\lib\site-packages\keras\backend\tensorflow\_backend.py:3652: The name tf.nn.max\_pool is deprecated. Please use tf.nn.max\_pool2d instead.

WARNING:tensorflow:From c:\CV-Proj\venv\lib\site-packages\keras\backend\tensorflow\_backend.py:1937: The name tf.image.resize\_nearest\_neighbor is deprecated. Please use tf.compat.v1.image.resize\_nearest\_neighbor instead.

WARNING:tensorflow:From c:\CV-Proj\venv\lib\site-packages\tensorflow\_core\python\ops\array\_ops.py:1475: where (from tensorflow.python.ops.array\_ops) is deprecated and will be removed in a future version.

Instructions for updating:

Use tf.where in 2.0, which has the same broadcast rule as np.where

WARNING:tensorflow:From c:\CV-Proj\Mask\_RCNN\mrcnn\model.py:553: The name tf.random\_shuffle is deprecated. Please use tf.random.shuffle instead.

WARNING:tensorflow:From c:\CV-Proj\Mask\_RCNN\mrcnn\utils.py:202: The name tf.log is deprecated. Please use tf.math.log instead.

WARNING:tensorflow:From c:\CV-Proj\Mask\_RCNN\mrcnn\model.py:600: calling crop\_and\_resize\_v1 (from tensorflow.python.ops.image\_ops\_impl) with box\_ind is deprecated and will be removed in a future version.

Instructions for updating:

box\_ind is deprecated, use box\_indices instead

WARNING:tensorflow:From c:\CV-Proj\venv\lib\site-packages\keras\backend\tensorflow\_backend.py:166: The name tf.get\_default\_session is deprecated. Please use tf.compat.v1.get\_default\_session instead.

WARNING:tensorflow:From c:\CV-Proj\venv\lib\site-packages\keras\backend\tensorflow\_backend.py:171: The name tf.ConfigProto is deprecated. Please use tf.compat.v1.ConfigProto instead.

WARNING:tensorflow:From c:\CV-Proj\venv\lib\site-packages\keras\backend\tensorflow\_backend.py:176: The name tf.Session is deprecated. Please use tf.compat.v1.Session instead.

WARNING:tensorflow:From c:\CV-Proj\venv\lib\site-packages\keras\backend\tensorflow\_backend.py:180: The name tf.global\_variables is deprecated. Please use tf.compat.v1.global\_variables instead.

WARNING:tensorflow:From c:\CV-Proj\venv\lib\site-packages\keras\backend\tensorflow\_backend.py:189: The name tf.is\_variable\_initialized is deprecated. Please use tf.compat.v1.is\_variable\_initialized instead.

WARNING:tensorflow:From c:\CV-Proj\venv\lib\site-packages\keras\backend\tensorflow\_backend.py:196: The name tf.variables\_initializer is deprecated. Please use tf.compat.v1.variables\_initializer instead.

## Train Model

```
In [6]: train_data = BuoyDataset()
train_data.load_buoys("train")
train_data.prepare()
val_data = BuoyDataset()
val_data.load_buoys("val")
val_data.prepare()
```

```
In [7]: model.train(train_data, val_data, learning_rate=BuoyConfig.LEARNING_RATE, epochs=5, lay
```

830: FutureWarning: Input image dtype is bool. Interpolation is not defined with bool data type. Please set order to 0 or explicitly cast input image to another data type. Starting from version 0.19 a ValueError will be raised instead of this warning.

order = \_validate\_interpolation\_order(image.dtype, order)  
499/500 [=====>.] - ETA: 0s - loss: 0.3580 - rpn\_class\_loss: 0.0127 - rpn\_bbox\_loss: 0.1326 - mrcnn\_class\_loss: 0.0089 - mrcnn\_bbox\_loss: 0.0746 - mrcnn\_mask\_loss: 0.1292c:\CV-Proj\venv\lib\site-packages\skimage\transform\\_warps.py:830: FutureWarning: Input image dtype is bool. Interpolation is not defined with bool data type. Please set order to 0 or explicitly cast input image to another data type. Starting from version 0.19 a ValueError will be raised instead of this warning.

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    order = validate interpolation order(image.dtype, order)
```

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```
order = _validate_interpolation_order(image.dtype, order)
```

500/500 [=====] - 403s 805ms/step - loss: 0.3576 - rpn\_class\_loss: 0.0127 - rpn\_bbox\_loss: 0.1324 - mrcnn\_class\_loss: 0.0089 - mrcnn\_bbox\_loss: 0.0745 - mrcnn\_mask\_loss: 0.1291 - val\_loss: 0.6705 - val\_rpn\_class\_loss: 0.0303 - val\_rpn\_bbox\_loss: 0.2164 - val\_mrcnn\_class\_loss: 0.0369 - val\_mrcnn\_bbox\_loss: 0.1579 - val\_mrcnn\_mask\_loss: 0.2290

Manually save model and end of training (model should already be saved by callbacks, but never hurts to be safe)

```
In [8]: model_path = os.path.join(MODEL_CHECKPOINT_DIR, "mask_rcnn_buoys.h5")
        model.keras_model.save_weights(model_path)
```

Inference Stage: Test baby test!

```
In [9]: class TestBuoy(BuoyConfig):
        pass

        model_test = modellib.MaskRCNN(mode="inference", config=TestBuoy(), model_dir=MODEL_CHECKPOINT_DIR)
        model_path = model_test.find_last()
        print(model_path)
        model_test.load_weights(model_path, by_name=True)
```

WARNING:tensorflow:From c:\CV-Proj\Mask\_RCNN\mrcnn\model.py:720: The name tf.sets.set\_intersection is deprecated. Please use tf.sets.intersection instead.

WARNING:tensorflow:From c:\CV-Proj\Mask\_RCNN\mrcnn\model.py:722: The name tf.sparse\_tensor\_to\_dense is deprecated. Please use tf.sparse.to\_dense instead.



WARNING:tensorflow:From c:\CV-Proj\Mask\_RCNN\mrcnn\model.py:772: to\_float (from tensorflow.python.ops.math\_ops) is deprecated and will be removed in a future version.  
Instructions for updating:  
Use `tf.cast` instead.  
c:\CV-Proj\models\bouy20210428T1854\mask\_rcnn\_bouy\_0005.h5  
Re-starting from epoch 5

```
In [10]: image_id = random.choice(val_data.image_ids)
orig, meta, gt_class, gt_bbox, gt_mask = modellib.load_image_gt(val_data, TestBuoy(), i
visualize.display_instances(orig, gt_bbox, gt_mask, gt_class,
                           train_data.class_names, figsize=(8, 8))
```



Utility function borrow Matterport/Mask\_RCNN/samples/train\_shapes.ipynb

```
In [11]: def get_ax(rows=1, cols=1, size=8):
        """Return a Matplotlib Axes array to be used in
        all visualizations in the notebook. Provide a
        central point to control graph sizes.
```

Change the default size attribute to control the size of rendered images

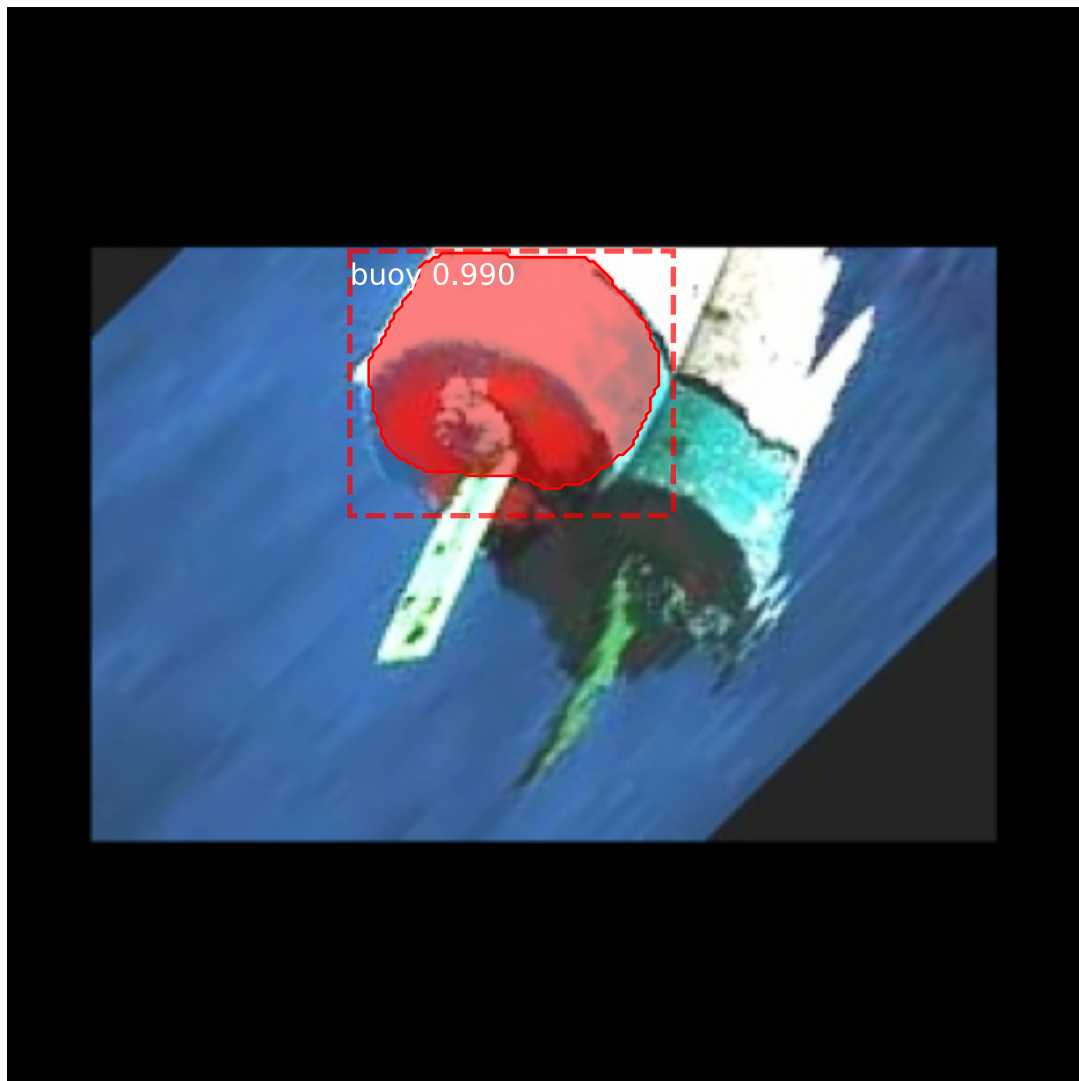
```
"""
_, ax = plt.subplots(rows, cols, figsize=(size*cols, size*rows))
return ax
```

In [12]:

```
results = model_test.detect([orig], verbose=1)
r = results[0]
visualize.display_instances(orig, r['rois'], r['masks'], r['class_ids'],
                           val_data.class_names, r['scores'], ax=get_ax())
```

Processing 1 images

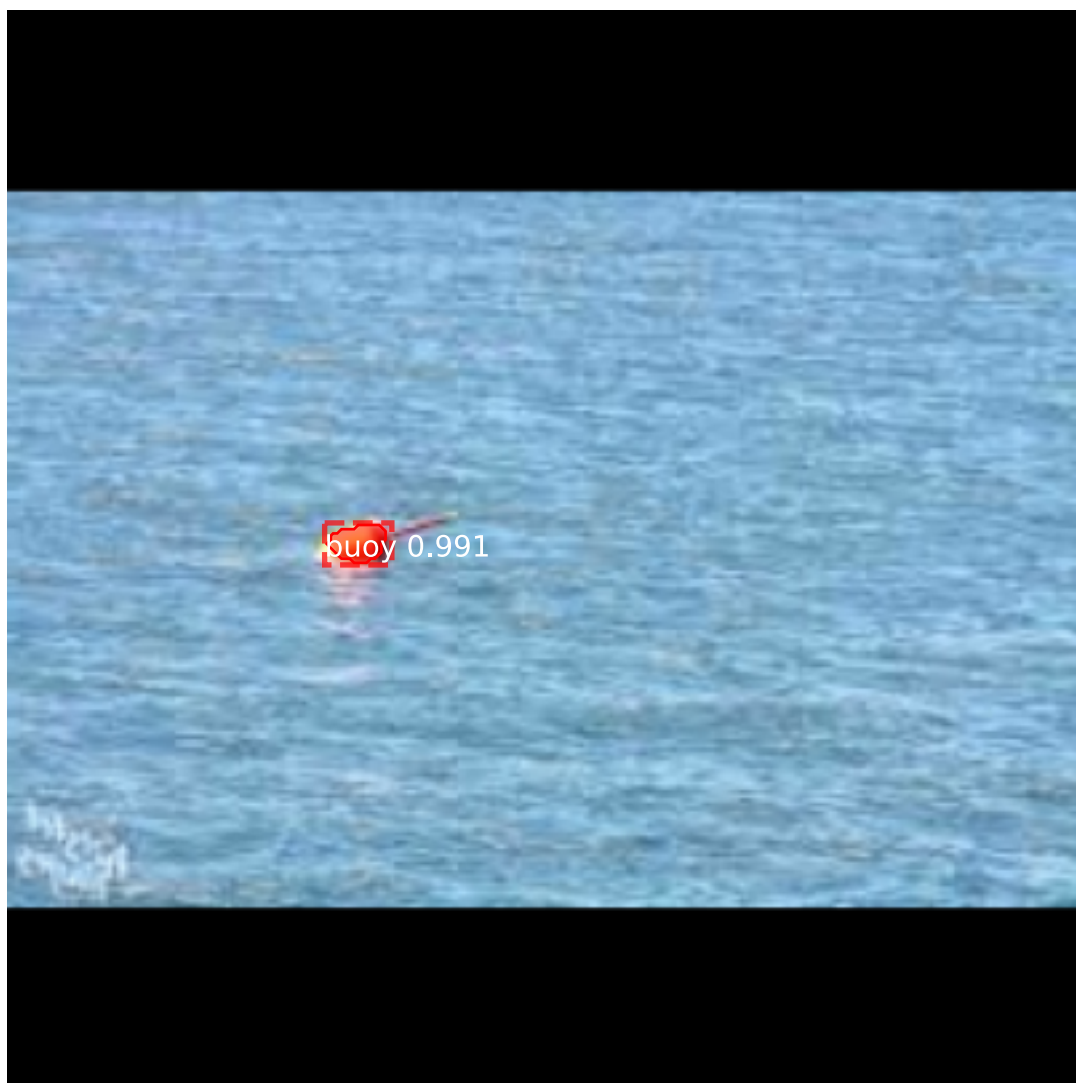
image	shape: (256, 256, 3)	min: 0.00000	max: 255.00000
uint8			
molded_images	shape: (1, 256, 256, 3)	min: -123.70000	max: 151.10000
float64			
image metas	shape: (1, 14)	min: 0.00000	max: 256.00000
int32			
anchors	shape: (1, 16368, 4)	min: -1.41976	max: 2.16878
float32			



In [18]:

```
image_ids = np.random.choice(val_data.image_ids, 3)
```

```
for im_id in image_ids:
    image, image_meta, gt_class_id, gt_bbox, gt_mask = \
        modellib.load_image_gt(val_data, TestBuoy(),
                                im_id, use_mini_mask=False)
    results = model_test.detect([image], verbose=0)
    r = results[0]
    visualize.display_instances(image, r['rois'], r['masks'], r['class_ids'],
                               val_data.class_names, r['scores'], ax=get_ax())
```







Compute mean Average Precision - utilizing script from Github repo  
 Matterport/Mask\_RCNN/samples/train\_shapes.ipynb

```
In [23]: # Compute VOC-Style mAP @ IoU=0.5
# Running on 10 images. Increase for better accuracy.
image_ids = np.random.choice(val_data.image_ids, 100)
APs = []
for image_id in image_ids:
    # Load image and ground truth data
    image, image_meta, gt_class_id, gt_bbox, gt_mask = \
        modellib.load_image_gt(val_data, TestBuoy(),
                                image_id, use_mini_mask=False)
    molded_images = np.expand_dims(modellib.mold_image(image, TestBuoy()), 0)
    # Run object detection
    results = model_test.detect([image], verbose=0)
    r = results[0]
    # Compute AP
    AP, precisions, recalls, overlaps = \
        utils.compute_ap(gt_bbox, gt_class_id, gt_mask,
                        r["rois"], r["class_ids"], r["scores"], r['masks'])
    APs.append(AP)
```

```
print("mAP: ", np.mean(APs))
```

```
mAP: 0.9642410719394684
```

```
In [ ]:
```