AIML Capstone Project - Autonomous Driving - Lee Thornquist

Problem Statement 1: Autonomous vehicles (AV) and intelligent transport systems (ITS) are the future of road transport. Automatic detection of vehicles on the road in real-time helps AV technology and makes ITS more intelligent in terms of vehicle tracking, vehicle counting, and road incident response.

Objective Statement 1: As the first part of this project, you need to develop an AI model using a deep learning framework that predicts the type of vehicle present in an image as well as localizes the vehicle by rectangular bounding box.

Part 1

1.1 Create a parent folder for custom model training and child folders to store data

```
import os

# define parent directory
parent_dir = 'yolov5_vehicle_detection'

# define child directories
child_dirs = ["data", "models", "results", "notebooks"]

# create parent directory
if not os.path.exists(parent_dir):
    os.makedirs(parent_dir)

# create child directories
for dir_name in child_dirs:
    dir_path = os.path.join(parent_dir, dir_name)
    if not os.path.exists(dir_path):
        os.makedirs(dir_path)
```

1.2 Prepare the dataset for model training

```
In [ ]: import pandas as pd
        import shutil
        import random
        # define paths
        data_dir = 'yolov5_vehicle_detection/data'
        images_dir = data_dir, 'Images'
        labels_csv = data_dir, 'labels.csv'
        labels_dir = os.path.join(data_dir, 'labels')
In [ ]: # create directories
        os.makedirs(labels_dir, exist_ok=True)
        os.makedirs(os.path.join(data_dir, 'images', 'train'), exist_ok=True)
        os.makedirs(os.path.join(data_dir, 'images', 'val'), exist_ok=True)
        os.makedirs(os.path.join(data_dir, 'images', 'test'), exist_ok=True)
        os.makedirs(os.path.join(labels_dir, 'train'), exist_ok=True)
        os.makedirs(os.path.join(labels_dir, 'val'), exist_ok=True)
        os.makedirs(os.path.join(labels_dir, 'test'), exist_ok=True)
        # I ended up manually changing these to the correct structure for the YOLOv8 model. Attached image shows how I structured the data.
```

```
In [ ]: # loading our data
        # Define column names
        column_names = ['image_id', 'vehicle_type', 'x_min', 'y_min', 'x_max', 'y_max']
        # Load the labels file with column names
        labels_df = pd.read_csv("yolov5_vehicle_detection/data/labels.csv", header=None, names=column_names)
        labels df
In [ ]: # making sure I have no missing values
        labels_df.isnull().sum()
In [ ]: labels_df['vehicle_type'].unique()
In [ ]: # Complete list of vehicle types and their numeric codes
        vehicle types = {
            'pickup_truck': 0,
            'car': 1,
            'articulated_truck': 2,
            'bus': 3,
            'motorized_vehicle': 4,
            'work_van': 5,
            'single_unit_truck': 6,
            'pedestrian': 7,
            'bicycle': 8,
            'non-motorized_vehicle': 9,
            'motorcycle': 10
In []: # Apply the vehicle type mapping
        labels_df['vehicle_type'] = labels_df['vehicle_type'].map(vehicle_types)
        # Check for any unmapped vehicle types resulting in NaN
        unmapped_vehicle_types = labels_df[labels_df['vehicle_type'].isna()]
        if not unmapped_vehicle_types.empty:
            print("Unmapped vehicle types found:")
            print(unmapped_vehicle_types)
        else:
            print("All vehicle types mapped successfully!")
In [ ]: # Image dimensions
        image_height = 480
        image_width = 720
        # Standardize the labels directly in the DataFrame
        labels_df['x_center'] = (labels_df['x_min'] + labels_df['x_max']) / 2.0 / image_width
        labels_df['y_center'] = (labels_df['y_min'] + labels_df['y_max']) / 2.0 / image_height
        labels_df['width'] = (labels_df['x_max'] - labels_df['x_min']) / image_width
        labels_df['height'] = (labels_df['y_max'] - labels_df['y_min']) / image_height
In [ ]: # Define the path to the labels directory
        labels_output_dir = os.path.join(data_dir, "labels_yolov5")
        # Create the labels directory if it doesn't exist
        if not os.path.exists(labels_output_dir):
            os.makedirs(labels_output_dir)
In []: # Function to write labels to YOLOv8 format text files
        def write_yolo_labels(image_id, group):
            file_path = os.path.join(labels_output_dir, f"{int(image_id):08d}.txt")
            with open(file_path, 'w') as f:
```

```
for , row in group.iterrows():
                    label = f"{int(row['vehicle type'])} {row['x center']:.6f} {row['y center']:.6f} {row['width']:.6f} {row['height']:.6f}\n"
                    f.write(label)
In []: # Group labels by image id and apply the function
        grouped = labels df.groupby('image id')
        grouped.apply(lambda group: write yolo labels(group.name, group))
In []: # Read and print the contents of a few label files to verify
        for label file in label files[:5]:
            file path = os.path.join(labels output dir, label file)
            print(f"\nContents of {label_file}:")
            with open(file path, 'r') as f:
                print(f.read())
In [ ]; from sklearn.model selection import train test split
        # Define base directories
        data dir = 'yolov5 vehicle detection/data'
        images_dir = os.path.join(data_dir, "Images")
        labels yolov5 dir = os.path.join(data dir, "labels yolov5")
        splits_dir = os.path.join(data_dir, "splits")
        output images dir = os.path.join(data dir, "images")
        output labels dir = os.path.join(data dir, "labels")
        # list all image files
        existing images = set(os.listdir(images dir))
In [ ]: # Ensure directories for splits
        os.makedirs(splits_dir, exist_ok=True)
        for split in ["train", "val", "test"]:
            os.makedirs(os.path.join(output_images_dir, split), exist_ok=True)
            os.makedirs(os.path.join(output_labels_dir, split), exist_ok=True)
In [ ]: # Function to create and save split datasets
        def create and save splits():
            train_df, temp_df = train_test_split(labels_df, test_size=0.3, random_state=42, stratify=labels_df['vehicle_type'])
            val_df, test_df = train_test_split(temp_df, test_size=0.5, random_state=42, stratify=temp_df['vehicle_type'])
            train_df.to_csv(os.path.join(splits_dir, 'train_labels.csv'), index=False)
            val_df.to_csv(os.path.join(splits_dir, 'val_labels.csv'), index=False)
            test_df.to_csv(os.path.join(splits_dir, 'test_labels.csv'), index=False)
            print("Split files created successfully!")
        # Check if split files exist, if not create them
        if not (os.path.exists(os.path.join(splits_dir, 'train_labels.csv')) and
                os.path.exists(os.path.join(splits_dir, 'val_labels.csv')) and
                os.path.exists(os.path.join(splits_dir, 'test_labels.csv'))):
            create_and_save_splits()
In [ ]: # Load split datasets
        train_df = pd.read_csv(os.path.join(splits_dir, "train_labels.csv"))
        val_df = pd.read_csv(os.path.join(splits_dir, "val_labels.csv"))
        test_df = pd.read_csv(os.path.join(splits_dir, "test_labels.csv"))
        # List all image files
        existing_images = set(os.listdir(images_dir))
In []: # Function to filter DataFrame to include only existing images
        def filter_existing_images(df):
            df['image_filename'] = df['image_id'].apply(lambda x: f"{int(x):08d}.jpg")
```

```
return df[df['image_filename'].isin(existing_images)]
        # Filter the DataFrames
        train_df_filtered = filter_existing_images(train_df)
        val_df_filtered = filter_existing_images(val_df)
        test_df_filtered = filter_existing_images(test_df)
In []: # Function to move files based on DataFrame
        def move files(df, split):
            missing_files = []
            for _, row in df.iterrows():
                image_id = f"{int(row['image_id']):08d}"
                image_filename = f"{image_id}.jpg"
                label filename = f"{image id}.txt"
                # Define source and destination paths
                src image path = os.path.join(images dir, image filename)
                src_label_path = os.path.join(labels_yolov5_dir, label_filename)
                dst_image_path = os.path.join(output_images_dir, split, image_filename)
                dst_label_path = os.path.join(output_labels_dir, split, label_filename)
                # Check if the image file exists before moving
                if os.path.exists(src image path) and os.path.exists(src label path):
                    shutil.move(src_image_path, dst_image_path)
                    shutil.move(src_label_path, dst_label_path)
                else:
                    missing_files.append(image_id)
            # Log missing files
            if missing_files:
                print(f"Missing files for image IDs: {missing files}")
        # Move files to corresponding directories
        move_files(train_df_filtered, "train")
        move files(val df filtered, "val")
        move_files(test_df_filtered, "test")
In [ ]: # creating the yaml file
        import yaml
        data = {
            'train': 'data/images/train',
            'val': 'data/images/val',
            'test': 'data/images/test',
            'nc': 11,
            'names': ['pickup_truck', 'car', 'articulated_truck', 'bus', 'motorized_vehicle', 'work_van', 'single_unit_truck', 'pedestrian', 'bicycle', 'non-motorized_vehicle', 'motorcycle']
        yaml_file_path = 'yolov5_vehicle_detection/data.yaml'
        with open(yaml_file_path, 'w') as yaml_file:
            yaml.dump(data, yaml_file, default_flow_style=False)
        print("YAML file created successfully!")
```

1.3 Create an CNN architecture for object detection (YOLOv8)

I originally started with trying to create a YOLOv5 model like we did in class (which is why some of my files have 'YOLOv5' in the name, but I realized there were updated YOLO models so I changed my model to YOLOv8

```
import ultralytics
from ultralytics import YOLO

# Load a YOLOv8 model
model = YOLO('yolov8s.pt') # Load the YOLOv8 architecture file
```

Ultralytics YOLOv8.2.28 Python-3.11.5 torch-2.2.2 CPU (Intel Core(TM) i5-7360U 2.30GHz)

engine/trainer: task=detect, mode=train, model=yolov8s.pt, data=/Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/07 - Capstone/Autonomous Driving/yolov5_vehicle_detection/
dataset.yaml, epochs=5, time=None, patience=100, batch=16, imgsz=640, save=True, save_period=-1, cache=False, device=None, workers=8, project=None, name=train15, exist_ok=False, pretrain
ed=True, optimizer=auto, verbose=True, seed=0, deterministic=True, single_cls=False, rect=False, cos_lr=False, close_mosaic=10, resume=False, amp=True, fraction=1.0, profile=False, freez
e=None, multi_scale=False, overlap_mask=True, mask_ratio=4, dropout=0.0, val=True, split=val, save_json=False, save_hybrid=False, conf=None, iou=0.7, max_det=300, half=False, dnn=False,
plots=True, source=None, vid_stride=1, stream_buffer=False, visualize=False, agnostic_nms=False, classes=None, retina_masks=False, embed=None, show=False, save_frames=False
e, save_txt=False, save_conf=False, save_crop=False, show_labels=True, show_conf=True, show_boxes=True, line_width=None, format=torchscript, keras=False, optimize=False, int8=False, dyna
mic=False, simplify=False, opset=None, workspace=4, nms=False, lr0=0.01, lrf=0.01, momentum=0.937, weight_decay=0.0005, warmup_epochs=3.0, warmup_momentum=0.8, warmup_bias_lr=0.1, box=7.
5, cls=0.5, dfl=1.5, pose=12.0, kobj=1.0, label_smoothing=0.0, nbs=64, hsv_h=0.015, hsv_s=0.7, hsv_v=0.4, degrees=0.0, translate=0.1, scale=0.5, shear=0.0, perspective=0.0, flipud=0.0, f
liplr=0.5, bgr=0.0, mosaic=1.0, mixup=0.0, copy_paste=0.0, auto_augment=randaugment, erasing=0.4, crop_fraction=1.0, cfg=None, tracker=botsort.yaml, save_dir=runs/detect/train15

Overriding model.yaml nc=80 with nc=11

	from	n	params	module	arguments
0	-1		928	ultralytics.nn.modules.conv.Conv	[3, 32, 3, 2]
1	-1	1	18560	ultralytics.nn.modules.conv.Conv	[32, 64, 3, 2]
2	-1	_	29056	ultralytics.nn.modules.block.C2f	[64, 64, 1, True]
3	-1 -1		73984	ultralytics.nn.modules.conv.Conv	[64, 128, 3, 2]
4	-1 -1		197632	ultralytics.nn.modules.block.C2f	[128, 128, 2, True]
5	-1 -1		295424		
				ultralytics.nn.modules.conv.Conv	[128, 256, 3, 2]
6	-1		788480	ultralytics.nn.modules.block.C2f	[256, 256, 2, True]
7	-1		1180672	ultralytics.nn.modules.conv.Conv	[256, 512, 3, 2]
8	-1		1838080	ultralytics.nn.modules.block.C2f	[512, 512, 1, True]
9	-1		656896	ultralytics.nn.modules.block.SPPF	[512, 512, 5]
10	-1		0	torch.nn.modules.upsampling.Upsample	[None, 2, 'nearest']
11	[-1, 6]	1	0	ultralytics.nn.modules.conv.Concat	[1]
12	-1	1	591360	ultralytics.nn.modules.block.C2f	[768, 256, 1]
13	-1	1	0	torch.nn.modules.upsampling.Upsample	[None, 2, 'nearest']
14	[-1, 4]	1	0	ultralytics.nn.modules.conv.Concat	[1]
15	-1	1	148224	ultralytics.nn.modules.block.C2f	[384, 128, 1]
16	-1	1	147712	ultralytics.nn.modules.conv.Conv	[128, 128, 3, 2]
17	[-1, 12]	1	0	ultralytics.nn.modules.conv.Concat	[1]
18	-1	1	493056	ultralytics.nn.modules.block.C2f	[384, 256, 1]
19	-1	1	590336	ultralytics.nn.modules.conv.Conv	[256, 256, 3, 2]
20	[-1, 9]	1	0	ultralytics.nn.modules.conv.Concat	[1]
21	-1	1	1969152	ultralytics.nn.modules.block.C2f	[768, 512, 1]
22	_	1	2120305	ultralytics.nn.modules.head.Detect	[11, [128, 256, 512]]
				arameters, 11139841 gradients, 28.7 GFLOPs	[11, [120, 230, 312]]
Houet	Junilary: 223 tayer	٠,	11133031 b	didileters, 11133041 graditeres, 2017 di LOFS	

Transferred 349/355 items from pretrained weights

TensorBoard: Start with 'tensorboard ——logdir runs/detect/train15', view at http://localhost:6006/Freezing layer 'model.22.dfl.conv.weight'

train: Scanning /Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/

train: New cache created: /Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/07 - Capstone/Autonomous Driving/yolov5_vehicle_detection/data/train/labels.cache

val: Scanning /Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/07

val: New cache created: /Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/07 - Capstone/Autonomous Driving/yolov5_vehicle_detection/data/val/labels.cache

Plotting labels to runs/detect/train15/labels.jpg...

optimizer: 'optimizer=auto' found, ignoring 'lr0=0.01' and 'momentum=0.937' and determining best 'optimizer', 'lr0' and 'momentum' automatically...

optimizer: AdamW(lr=0.000667, momentum=0.9) with parameter groups 57 weight(decay=0.0), 64 weight(decay=0.0005), 63 bias(decay=0.0)

TensorBoard: model graph visualization added ✓

Image sizes 640 train, 640 val

Using 0 dataloader workers

Logging results to runs/detect/train15

Starting training for 5 epochs...

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size	
1/5	0G Class		2.107 Instances		41 R	640: 1 mAP50 m	
	all	386	525	0.59	0.272	0.359	0.264
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size	

2/5	0G Class	1.196 Images	1.295 Instances	1.091 Box(P	42 R	640: 1 mAP50 m	
	all	386	525	0.48	0.467	0.403	0.276
E b	CDIL	harri Taran	-1- 1	161 1	T	C :	
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size	
3/5	0G	1.157	1.197	1.07	66	640: 1	
	Class	Images	Instances	Box(P	R	mAP50 m	
	all	386	525	0.526	0.456	0.485	0.346
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size	
4/5	0G	1.121	1.098	1.055	31	640: 1	
	Class	Images	Instances	Box(P	R	mAP50 m	
	all	386	525	0.596	0.525	0.526	0.396
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size	
5/5	0G	1.072	0.9667	1.029	33	640: 1	
	Class	Images	Instances	Box(P	R	mAP50 m	
	all	386	525	0.654	0.534	0.599	0.452

5 epochs completed in 17.988 hours.

Optimizer stripped from runs/detect/train15/weights/last.pt, 22.5MB Optimizer stripped from runs/detect/train15/weights/best.pt, 22.5MB

Validating runs/detect/train15/weights/best.pt...

Ultralytics YOLOv8.2.28 ♥ Python-3.11.5 torch-2.2.2 CPU (Intel Core(TM) i5-7360U 2.30GHz)

Model summary (fused): 168 layers, 11129841 parameters, 0 gradients, 28.5 GFLOPs

Class	Images	Instances	Box(P	R	mAP50	m
all	386	525	0.653	0.534	0.601	0.454
pickup_truck	80	84	0.711	0.558	0.597	0.505
car	255	324	0.764	0.787	0.796	0.626
articulated_truck	21	21	0.554	0.667	0.704	0.549
bus	33	33	0.924	0.879	0.954	0.833
<pre>motorized_vehicle</pre>	28	28	0.345	0.179	0.213	0.126
work_van	14	15	0.364	0.267	0.246	0.193
single_unit_truck	7	7	0.585	0.286	0.393	0.301
pedestrian	2	3	0.743	1	0.995	0.675
bicycle	4	4	0.681	1	0.995	0.746
<pre>non_motorized_vehicle</pre>	2	2	1	0	0.0101	0.00705
motorcycle	4	4	0.515	0.25	0.705	0.436

Speed: 2.9ms preprocess, 367.5ms inference, 0.0ms loss, 1.1ms postprocess per image Results saved to runs/detect/train15

1.4 Evaluate the Model and Check the Test Results

In [2]: # Evaluate the model on validation data val_results = model.val() print(val_results) Model summary (fused): 168 layers, 11129841 parameters, 0 gradients, 28.5 GFLOPs

val: Scanning /Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/07

Class Images Instances Box(P R

all	386	525	0.653	0.534	0.601	0.454
pickup_truck	80	84	0.711	0.558	0.597	0.505
car	255	324	0.764	0.787	0.796	0.626
articulated_truck	21	21	0.554	0.667	0.704	0.549
bus	33	33	0.924	0.879	0.954	0.833
<pre>motorized_vehicle</pre>	28	28	0.345	0.179	0.213	0.126
work_van	14	15	0.364	0.267	0.246	0.193
single_unit_truck	7	7	0.585	0.286	0.393	0.301
pedestrian	2	3	0.743	1	0.995	0.675
bicycle	4	4	0.681	1	0.995	0.746
<pre>non_motorized_vehicle</pre>	2	2	1	0	0.0101	0.00705
motorcycle	4	4	0.515	0.25	0.705	0.436

Speed: 3.9ms preprocess, 425.8ms inference, 0.0ms loss, 1.4ms postprocess per image

```
Results saved to runs/detect/train152
ultralytics.utils.metrics.DetMetrics object with attributes:
ap_class_index: array([ 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10])
box: ultralytics.utils.metrics.Metric object
confusion matrix: <ultralvtics.utils.metrics.ConfusionMatrix object at 0x155dbdb10>
curves: ['Precision-Recall(B)', 'F1-Confidence(B)', 'Precision-Confidence(B)', 'Recall-Confidence(B)']
curves results: [[array([
                                                                      0.003003, 0.004004,
                                                                                                                             0.007007,
                                                                                                                                           0.008008,
                                                                                                                                                         0.009009,
                                                                                                                                                                        0.01001,
                                                                                                                                                                                     0.011011,
                                    0, 0.001001, 0.002002,
                                                                                                  0.005005,
                                                                                                                0.006006,
                                                                                                             0.02002,
012012,
           0.013013,
                        0.014014,
                                     0.015015,
                                                    0.016016,
                                                                  0.017017,
                                                                               0.018018,
                                                                                              0.019019,
                                                                                                                         0.021021,
                                                                                                                                       0.022022,
                                                                                                                                                     0.023023,
          0.024024,
                        0.025025,
                                     0.026026,
                                                   0.027027,
                                                                 0.028028,
                                                                               0.029029,
                                                                                              0.03003,
                                                                                                          0.031031,
                                                                                                                        0.032032,
                                                                                                                                      0.033033,
                                                                                                                                                    0.034034,
                                                                                                                                                                  0.035035,
                                                                                                                                                                                0.036036,
                                                                                                                                                                                             0.03703
7,
      0.038038,
                   0.039039,
                                  0.04004,
                                               0.041041,
                                                             0.042042,
                                                                          0.043043,
                                                                                        0.044044,
                                                                                                      0.045045,
                                                                                                                    0.046046,
                                                                                                                                 0.047047,
          0.048048,
                        0.049049,
                                       0.05005,
                                                   0.051051,
                                                                 0.052052,
                                                                               0.053053,
                                                                                            0.054054,
                                                                                                          0.055055,
                                                                                                                        0.056056,
                                                                                                                                      0.057057,
                                                                                                                                                    0.058058,
                                                                                                                                                                  0.059059,
                                                                                                                                                                                0.06006,
                                                                                                                                                                                             0.06106
      0.062062,
                   0.063063,
                                 0.064064,
                                               0.065065,
                                                             0.066066,
                                                                          0.067067,
                                                                                        0.068068,
                                                                                                      0.069069,
                                                                                                                     0.07007,
                                                                                                                                 0.071071,
1,
                        0.073073,
                                                                               0.077077,
                                                                                            0.078078,
                                                                                                                                                    0.082082.
          0.072072.
                                     0.074074,
                                                   0.075075,
                                                                 0.076076,
                                                                                                          0.079079,
                                                                                                                         0.08008.
                                                                                                                                      0.081081.
                                                                                                                                                                  0.083083,
                                                                                                                                                                                0.084084,
                                                                                                                                                                                             0.08508
5,
      0.086086.
                   0.087087.
                                 0.088088,
                                               0.089089.
                                                              0.09009.
                                                                          0.091091.
                                                                                        0.092092.
                                                                                                      0.093093.
                                                                                                                    0.094094.
                                                                                                                                 0.095095.
          0.096096,
                        0.097097,
                                     0.098098,
                                                   0.099099,
                                                                   0.1001,
                                                                                 0.1011,
                                                                                               0.1021,
                                                                                                             0.1031,
                                                                                                                          0.1041,
                                                                                                                                       0.10511.
                                                                                                                                                     0.10611,
                                                                                                                                                                   0.10711,
                                                                                                                                                                                0.10811,
                                                                                                                                                                                              0.1091
                     0.11111,
                                  0.11211,
                                                0.11311,
                                                              0.11411,
                                                                            0.11512,
                                                                                         0.11612,
                                                                                                       0.11712,
                                                                                                                     0.11812,
                                                                                                                                   0.11912,
       0.11011,
1,
                         0.12112,
                                       0.12212,
                                                    0.12312,
                                                                  0.12412,
                                                                                0.12513,
                                                                                              0.12613,
           0.12012,
                                                                                                            0.12713,
                                                                                                                         0.12813,
                                                                                                                                                     0.13013,
                                                                                                                                                                                              0.1331
                                                                                                                                       0.12913.
                                                                                                                                                                   0.13113,
                                                                                                                                                                                0.13213,
       0.13413,
                     0.13514,
                                  0.13614,
                                                0.13714,
                                                              0.13814,
                                                                            0.13914,
                                                                                          0.14014,
                                                                                                       0.14114,
                                                                                                                     0.14214,
                                                                                                                                   0.14314,
3,
           0.14414,
                         0.14515,
                                       0.14615,
                                                    0.14715,
                                                                  0.14815,
                                                                                0.14915,
                                                                                              0.15015,
                                                                                                            0.15115,
                                                                                                                         0.15215,
                                                                                                                                       0.15315,
                                                                                                                                                     0.15415,
                                                                                                                                                                   0.15516,
                                                                                                                                                                                0.15616,
                                                                                                                                                                                              0.1571
                                  0.16016,
                                                                                                       0.16517,
       0.15816,
                     0.15916,
                                                0.16116,
                                                              0.16216,
                                                                            0.16316,
                                                                                          0.16416,
                                                                                                                     0.16617,
                                                                                                                                   0.16717,
6,
           0.16817,
                         0.16917,
                                                    0.17117,
                                                                                0.17317,
                                                                                              0.17417,
                                                                                                            0.17518,
                                                                                                                         0.17618,
                                                                                                                                       0.17718.
                                                                                                                                                     0.17818,
                                                                                                                                                                   0.17918,
                                                                                                                                                                                              0.1811
                                       0.17017,
                                                                  0.17217,
                                                                                                                                                                                0.18018,
                                                0.18519,
                                                                            0.18719,
                                                                                          0.18819,
                                                                                                       0.18919,
                                                                                                                     0.19019,
                                                                                                                                   0.19119.
8,
       0.18218,
                     0.18318,
                                  0.18418,
                                                              0.18619,
           0.19219.
                         0.19319.
                                       0.19419,
                                                      0.1952,
                                                                   0.1962,
                                                                                 0.1972,
                                                                                               0.1982,
                                                                                                             0.1992,
                                                                                                                          0.2002,
                                                                                                                                        0.2012,
                                                                                                                                                      0.2022,
                                                                                                                                                                    0.2032,
                                                                                                                                                                                 0.2042,
                                                                                                                                                                                              0.2052
                                  0.20821,
                                                                            0.21121,
       0.20621,
                                                0.20921,
                                                                                                       0.21321,
                                                                                                                     0.21421,
                     0.20721,
                                                              0.21021,
                                                                                          0.21221,
                                                                                                                                   0.21522,
1,
           0.21622,
                         0.21722,
                                       0.21822,
                                                    0.21922,
                                                                  0.22022,
                                                                                0.22122,
                                                                                              0.22222,
                                                                                                            0.22322,
                                                                                                                         0.22422.
                                                                                                                                       0.22523,
                                                                                                                                                     0.22623,
                                                                                                                                                                   0.22723,
                                                                                                                                                                                0.22823,
                                                                                                                                                                                              0.2292
       0.23023,
                     0.23123,
                                  0.23223,
                                                0.23323,
                                                              0.23423,
                                                                            0.23524,
                                                                                          0.23624,
                                                                                                       0.23724,
                                                                                                                     0.23824,
                                                                                                                                   0.23924,
3,
                                                                                                                                       0.24925,
           0.24024,
                         0.24124,
                                       0.24224,
                                                    0.24324,
                                                                  0.24424,
                                                                                0.24525,
                                                                                              0.24625,
                                                                                                            0.24725,
                                                                                                                         0.24825,
                                                                                                                                                     0.25025,
                                                                                                                                                                   0.25125,
                                                                                                                                                                                0.25225,
                                                                                                                                                                                              0.2532
                     0.25526,
                                  0.25626,
                                                0.25726,
                                                              0.25826,
                                                                            0.25926,
                                                                                          0.26026,
                                                                                                       0.26126,
                                                                                                                     0.26226,
5,
       0.25425,
                                                                                                                                   0.26326,
           0.26426,
                         0.26527,
                                       0.26627,
                                                    0.26727,
                                                                  0.26827,
                                                                                0.26927,
                                                                                              0.27027,
                                                                                                            0.27127,
                                                                                                                         0.27227,
                                                                                                                                       0.27327,
                                                                                                                                                     0.27427,
                                                                                                                                                                   0.27528,
                                                                                                                                                                                0.27628,
                                                                                                                                                                                              0.2772
                                  0.28028,
8,
       0.27828,
                     0.27928,
                                                0.28128,
                                                              0.28228,
                                                                            0.28328,
                                                                                          0.28428,
                                                                                                       0.28529,
                                                                                                                     0.28629,
                                                                                                                                   0.28729,
                         0.28929,
                                                                  0.29229,
                                                                                              0.29429,
                                                                                                                          0.2963,
                                                                                                                                        0.2973,
                                                                                                                                                      0.2983,
           0.28829,
                                       0.29029,
                                                    0.29129,
                                                                                0.29329,
                                                                                                             0.2953,
                                                                                                                                                                    0.2993,
                                                                                                                                                                                 0.3003,
                                                                                                                                                                                               0.301
                      0.3033,
                                    0.3043,
                                                0.30531,
                                                              0.30631,
                                                                            0.30731,
                                                                                          0.30831,
                                                                                                       0.30931,
                                                                                                                     0.31031,
                                                                                                                                   0.31131,
3,
        0.3023,
                                       0.31431,
                                                    0.31532,
                                                                                0.31732,
                                                                                              0.31832,
                                                                                                                         0.32032,
                                                                                                                                       0.32132,
                                                                                                                                                     0.32232,
                                                                                                                                                                                              0.3253
           0.31231,
                         0.31331,
                                                                  0.31632,
                                                                                                            0.31932,
                                                                                                                                                                   0.32332,
                                                                                                                                                                                0.32432,
3,
       0.32633,
                     0.32733,
                                  0.32833,
                                                0.32933,
                                                              0.33033,
                                                                            0.33133,
                                                                                          0.33233,
                                                                                                       0.33333,
                                                                                                                     0.33433,
                                                                                                                                   0.33534,
                                                                                              0.34234,
           0.33634,
                         0.33734,
                                       0.33834,
                                                    0.33934,
                                                                  0.34034,
                                                                                0.34134,
                                                                                                            0.34334,
                                                                                                                         0.34434,
                                                                                                                                       0.34535,
                                                                                                                                                     0.34635,
                                                                                                                                                                   0.34735,
                                                                                                                                                                                0.34835,
                                                                                                                                                                                              0.3493
5,
       0.35035,
                     0.35135,
                                  0.35235,
                                                0.35335,
                                                              0.35435,
                                                                            0.35536,
                                                                                          0.35636,
                                                                                                       0.35736,
                                                                                                                     0.35836,
                                                                                                                                   0.35936,
           0.36036,
                                       0.36236,
                                                    0.36336,
                                                                  0.36436,
                                                                                0.36537,
                                                                                                            0.36737,
                                                                                                                         0.36837,
                                                                                                                                       0.36937,
                                                                                                                                                     0.37037,
                                                                                                                                                                   0.37137,
                                                                                                                                                                                0.37237,
                                                                                                                                                                                              0.3733
                         0.36136,
                                                                                              0.36637,
       0.37437,
                     0.37538,
                                  0.37638,
                                                0.37738,
                                                              0.37838,
                                                                            0.37938,
                                                                                          0.38038,
                                                                                                       0.38138,
                                                                                                                     0.38238,
                                                                                                                                   0.38338,
7,
                                                                  0.38839,
                                                                                0.38939,
                                                                                                                         0.39239,
                                                                                                                                       0.39339,
                                                                                                                                                                                               0.397
           0.38438,
                         0.38539,
                                       0.38639,
                                                    0.38739,
                                                                                              0.39039,
                                                                                                            0.39139,
                                                                                                                                                     0.39439,
                                                                                                                                                                    0.3954,
                                                                                                                                                                                 0.3964,
                                                                             0.4034,
4,
        0.3984,
                      0.3994,
                                    0.4004,
                                                  0.4014,
                                                               0.4024,
                                                                                           0.4044,
                                                                                                       0.40541,
                                                                                                                     0.40641,
                                                                                                                                   0.40741,
            0.40841,
                         0.40941,
                                       0.41041,
                                                    0.41141,
                                                                                0.41341,
                                                                                                            0.41542,
                                                                                                                         0.41642,
                                                                                                                                                     0.41842,
                                                                                                                                                                                              0.4214
                                                                  0.41241,
                                                                                              0.41441,
                                                                                                                                       0.41742,
                                                                                                                                                                   0.41942,
                                                                                                                                                                                0.42042,
       0.42242,
                     0.42342,
                                  0.42442,
                                                0.42543,
                                                              0.42643,
                                                                            0.42743,
                                                                                          0.42843,
                                                                                                       0.42943,
                                                                                                                     0.43043,
                                                                                                                                   0.43143,
2,
           0.43243,
                         0.43343,
                                       0.43443,
                                                    0.43544,
                                                                  0.43644,
                                                                                0.43744,
                                                                                              0.43844,
                                                                                                            0.43944,
                                                                                                                         0.44044,
                                                                                                                                       0.44144,
                                                                                                                                                     0.44244,
                                                                                                                                                                   0.44344,
                                                                                                                                                                                0.44444,
                                                                                                                                                                                              0.4454
                                                                                                                     0.45445,
       0.44645,
                     0.44745,
                                  0.44845,
                                                0.44945,
                                                              0.45045,
                                                                            0.45145,
                                                                                          0.45245,
                                                                                                       0.45345,
                                                                                                                                   0.45546,
5,
           0.45646,
                                       0.45846,
                                                    0.45946,
                                                                  0.46046,
                                                                                0.46146,
                                                                                                            0.46346,
                                                                                                                         0.46446,
                                                                                                                                                     0.46647,
                                                                                                                                                                                0.46847,
                                                                                                                                                                                              0.4694
                         0.45746,
                                                                                              0.46246,
                                                                                                                                       0.46547,
                                                                                                                                                                   0.46747,
7,
       0.47047,
                     0.47147,
                                  0.47247,
                                                0.47347,
                                                              0.47447,
                                                                            0.47548,
                                                                                          0.47648,
                                                                                                       0.47748,
                                                                                                                     0.47848,
                                                                                                                                   0.47948,
           0.48048,
                         0.48148,
                                                    0.48348,
                                                                  0.48448,
                                                                                0.48549,
                                                                                              0.48649,
                                                                                                                         0.48849,
                                                                                                                                       0.48949,
                                                                                                                                                     0.49049,
                                                                                                                                                                   0.49149,
                                                                                                                                                                                0.49249,
                                                                                                                                                                                              0.4934
                                       0.48248,
                                                                                                            0.48749,
9,
       0.49449,
                                    0.4965,
                                                  0.4975,
                                                               0.4985,
                                                                             0.4995,
                                                                                                        0.5015,
                                                                                                                      0.5025,
                                                                                                                                    0.5035,
                      0.4955,
                                                                                           0.5005,
                                                    0.50751,
                                                                  0.50851,
                                                                                0.50951,
                                                                                                                         0.51251,
            0.5045,
                         0.50551,
                                       0.50651,
                                                                                              0.51051,
                                                                                                            0.51151,
                                                                                                                                       0.51351,
                                                                                                                                                     0.51451,
                                                                                                                                                                   0.51552,
                                                                                                                                                                                0.51652,
                                                                                                                                                                                              0.5175
       0.51852,
                     0.51952,
                                  0.52052,
                                                0.52152,
                                                              0.52252,
                                                                            0.52352,
                                                                                          0.52452,
                                                                                                       0.52553,
                                                                                                                     0.52653,
                                                                                                                                   0.52753,
2,
                                                                                                                                                     0.53854,
                         0.52953,
                                                    0.53153,
                                                                                0.53353,
                                                                                              0.53453,
                                                                                                            0.53554,
                                                                                                                         0.53654,
                                                                                                                                       0.53754,
                                                                                                                                                                   0.53954,
                                                                                                                                                                                0.54054,
                                                                                                                                                                                              0.5415
           0.52853,
                                       0.53053,
                                                                  0.53253,
       0.54254,
                     0.54354,
                                  0.54454,
                                                 0.54555,
                                                              0.54655,
                                                                            0.54755,
                                                                                          0.54855,
                                                                                                       0.54955,
                                                                                                                     0.55055,
                                                                                                                                   0.55155,
```

```
0.55556,
                                                 0.55656,
                                                           0.55756,
                                                                     0.55856,
                                                                               0.55956,
                                                                                         0.56056,
                                                                                                              0.56256,
                                                                                                                        0.56356,
                                                                                                                                  0.56456,
                                                                                                                                             0.5655
                  0.55355,
                            0.55455,
                                                                                                    0.56156.
     0.56657, 0.56757, 0.56857, 0.56957, 0.57057, 0.57157, 0.57257, 0.57357, 0.57457, 0.57558,
7,
        0.57658, 0.57758, 0.57858, 0.57958, 0.58058, 0.58158, 0.58258, 0.58358, 0.58458, 0.58559,
                                                                                                                                             0.5895
                                                                                                              0.58659,
                                                                                                                        0.58759,
                                                                                                                                  0.58859,
     0.59059,
             0.59159, 0.59259, 0.59359, 0.59459, 0.5956,
                                                               0.5966, 0.5976,
                                                                                      0.5986,
                                                                                                 0.5996,
                0.6016, 0.6026, 0.6036, 0.6046, 0.60561, 0.60661, 0.60761, 0.60861,
         0.6006,
                                                                                                 0.60961.
                                                                                                              0.61061,
                                                                                                                        0.61161,
                                                                                                                                  0.61261,
                                                                                                                                             0.6136
               0.61562,
                         0.61662, 0.61762, 0.61862, 0.61962, 0.62062, 0.62162, 0.62262, 0.62362,
     0.61461,
1,
        0.62462,
                  0.62563, 0.62663, 0.62763, 0.62863, 0.62963,
                                                                     0.63063, 0.63163,
                                                                                         0.63263, 0.63363,
                                                                                                                        0.63564,
                                                                                                                                  0.63664,
                                                                                                                                             0.6376
                                                                                                              0.63463,
                                   0.64164, 0.64264, 0.64364, 0.64464, 0.64565,
     0.63864,
               0.63964,
                         0.64064,
                                                                                      0.64665, 0.64765,
        0.64865,
                  0.64965, 0.65065, 0.65165, 0.65265, 0.65365, 0.65465, 0.65566, 0.65666, 0.65766,
                                                                                                              0.65866,
                                                                                                                        0.65966,
                                                                                                                                  0.66066,
                                                                                                                                            0.6616
                                   0.66567, 0.66667, 0.66767, 0.66867, 0.66967, 0.67067, 0.67167,
     0.66266,
               0.66366,
                         0.66466,
6,
        0.67267,
                  0.67367, 0.67467, 0.67568, 0.67668, 0.67768, 0.67868, 0.67968, 0.68068,
                                                                                                 0.68168.
                                                                                                              0.68268,
                                                                                                                        0.68368,
                                                                                                                                  0.68468,
                                                                                                                                            0.6856
               0.68769, 0.68869, 0.68969, 0.69069, 0.69169, 0.69269, 0.69369, 0.69469,
9,
     0.68669,
                                                                                                 0.6957,
                   0.6977, 0.6987, 0.6997, 0.7007, 0.7017, 0.7027, 0.7037, 0.7047,
                                                                                                              0.70671,
                                                                                                                                             0.7097
                                                                                                   0.70571.
                                                                                                                        0.70771,
                                                                                                                                  0.70871,
              0.71171, 0.71271, 0.71371, 0.71471, 0.71572, 0.71672, 0.71772, 0.71872, 0.71972,
     0.71071,
1,
        0.72072, 0.72172, 0.72272, 0.72372, 0.72472, 0.72573, 0.72673, 0.72773, 0.72873, 0.72973,
                                                                                                              0.73073,
                                                                                                                        0.73173,
                                                                                                                                  0.73273,
                                                                                                                                             0.7337
3,
     0.73473,
              0.73574,
                      0.73674, 0.73774, 0.73874, 0.73974, 0.74074, 0.74174, 0.74274, 0.74374,
        0.74474, 0.74575, 0.74675, 0.74775, 0.74875, 0.74975, 0.75075, 0.75175, 0.75275, 0.75375,
                                                                                                              0.75475,
                                                                                                                        0.75576,
                                                                                                                                  0.75676,
                                                                                                                                            0.7577
                         0.76076, 0.76176, 0.76276, 0.76376, 0.76476, 0.76577, 0.76677, 0.76777,
              0.75976,
        0.76877,
                  0.76977, 0.77077, 0.77177, 0.77277, 0.77377, 0.77477, 0.77578,
                                                                                         0.77678, 0.77778,
                                                                                                              0.77878.
                                                                                                                        0.77978,
                                                                                                                                  0.78078.
                                                                                                                                             0.7817
                                   0.78579, 0.78679, 0.78779, 0.78879, 0.78979, 0.79079, 0.79179,
8,
     0.78278,
              0.78378,
                         0.78478,
        0.79279, 0.79379, 0.79479, 0.7958, 0.7968, 0.7978, 0.7988, 0.7998, 0.8008, 0.8018,
                                                                                                               0.8028,
                                                                                                                         0.8038,
                                                                                                                                            0.8058
                                                                                                                                   0.8048,
                         0.80881, 0.80981, 0.81081, 0.81181, 0.81281, 0.81381, 0.81481, 0.81582,
     0.80681,
               0.80781,
1,
        0.81682,
               0.81782, 0.81882, 0.81982, 0.82082, 0.82182, 0.82282, 0.82382, 0.82482, 0.82583,
                                                                                                              0.82683,
                                                                                                                        0.82783,
                                                                                                                                  0.82883,
                                                                                                                                            0.8298
                                   0.83383, 0.83483, 0.83584, 0.83684, 0.83784, 0.83884, 0.83984,
3,
     0.83083,
               0.83183,
                         0.83283,
                 0.84184, 0.84284, 0.84384, 0.84484, 0.84585, 0.84685, 0.84785, 0.84885,
                                                                                                              0.85085,
                                                                                                                        0.85185,
                                                                                                                                  0.85285,
                                                                                                                                             0.8538
                                           0.85886, 0.85986, 0.86086, 0.86186, 0.86286,
     0.85485,
              0.85586, 0.85686, 0.85786,
                                                                                              0.86386,
5,
        0.86486, 0.86587, 0.86687, 0.86787, 0.86887, 0.86987, 0.87087, 0.87187, 0.87287, 0.87387,
                                                                                                                        0.87588,
                                                                                                                                  0.87688,
                                                                                                                                             0.8778
                                                                                                              0.87487.
8,
     0.87888.
              0.87988, 0.88088, 0.88188, 0.88288, 0.88388, 0.88488, 0.88589, 0.88689, 0.88789,
        0.88889,
                0.88989, 0.89089, 0.89189, 0.89289, 0.89389, 0.89489, 0.8959, 0.8969,
                                                                                                 0.8979.
                                                                                                               0.8989.
                                                                                                                         0.8999,
                                                                                                                                   0.9009,
                                                                                                                                             0.901
                                   0.90591, 0.90691, 0.90791, 0.90891, 0.90991, 0.91091, 0.91191,
      0.9029,
                0.9039,
                          0.9049,
                  0.91391, 0.91491, 0.91592, 0.91692, 0.91792, 0.91892, 0.91992, 0.92092,
                                                                                                                                             0.9259
        0.91291,
                                                                                                              0.92292,
                                                                                                                        0.92392,
                                                                                                                                  0.92492,
     0.92693,
               0.92793, 0.92893, 0.92993, 0.93093, 0.93193, 0.93293, 0.93393, 0.93493, 0.93594,
3,
                  0.93794, 0.93894, 0.93994, 0.94094, 0.94194, 0.94294, 0.94394, 0.94494, 0.94595,
                                                                                                              0.94695,
                                                                                                                        0.94795,
                                                                                                                                  0.94895,
                                                                                                                                             0.9499
        0.93694,
                                           0.95495, 0.95596,
     0.95095,
               0.95195,
                      0.95295, 0.95395,
                                                               0.95696, 0.95796, 0.95896, 0.95996,
5,
        0.96096,
                  0.96196, 0.96296, 0.96396, 0.96496, 0.96597, 0.96697, 0.96797, 0.96897,
                                                                                                   0.96997.
                                                                                                                                  0.97297,
                                                                                                                                             0.9739
                                                                                                              0.97097,
                                                                                                                        0.97197,
                                   0.97798, 0.97898, 0.97998,
                                                                 0.98098, 0.98198, 0.98298, 0.98398,
7,
     0.97497.
               0.97598, 0.97698,
                  0.98599, 0.98699, 0.98799, 0.98899, 0.98999, 0.99099, 0.99199, 0.99299,
                                                                                                              0.99499.
                                                                                                                          0.996,
                                                                                                                                    0.997,
                                                                                                                                              0.99
                                     1,
       0.999,
                   1]), array([[
                                                          1, ..., 0.0020923, 0.0010462,
                                                1,
                                  1, ..., 0.00094144, 0.00047072,
                                                                    0],
                        1,
             1,
                                  1, ..., 0.0010948, 0.00054742,
              1,
                        1,
                                  1, ...,
                                                                    0],
        0.018519,
                  0.018519,
                          0.018519, ..., 1.4249e-05, 7.1246e-06,
                                                                    0],
                  1,
                                                                0]]), 'Recall', 'Precision'], [array([ 0, 0.001001, 0.002002,
                           1, ..., 0.57143, 0.57143,
                                                                                                                                   0.003003,
      0.005005, 0.006006, 0.007007, 0.008008, 0.009009, 0.01001, 0.011011, 0.012012, 0.013013, 0.014014, 0.015015,
                                                                                                                     0.016016,
                                                                                                                                0.017017, 0.018018,
0.019019, 0.02002, 0.021021, 0.022022, 0.023023,
       0.024024, 0.025025, 0.026026, 0.027027, 0.028028, 0.029029, 0.03003, 0.031031, 0.032032, 0.033033,
                                                                                                             0.034034,
                                                                                                                       0.035035,
                                                                                                                                  0.036036,
                                                                                                                                            0.03703
    0.038038, 0.039039, 0.04004, 0.041041, 0.042042, 0.043043, 0.044044, 0.045045, 0.046046, 0.047047,
       0.048048, 0.049049, 0.05005, 0.051051, 0.052052, 0.053053, 0.054054, 0.055055, 0.056056, 0.057057,
                                                                                                             0.058058,
                                                                                                                       0.059059,
                                                                                                                                            0.06106
                                                                                                                                  0.06006,
             0.063063, 0.064064, 0.065065, 0.066066, 0.067067, 0.068068, 0.069069, 0.07007, 0.071071,
       0.072072, 0.073073, 0.074074, 0.075075, 0.076076, 0.077077, 0.078078, 0.079079, 0.08008, 0.081081,
                                                                                                             0.082082,
                                                                                                                        0.083083,
                                                                                                                                  0.084084,
                                                                                                                                            0.08508
    0.086086, 0.087087, 0.088088, 0.089089, 0.09009, 0.091091, 0.092092, 0.093093, 0.094094, 0.095095,
5,
                 0.097097, 0.098098, 0.099099, 0.1001, 0.1011, 0.1021, 0.1031,
       0.096096,
                                                                                         0.1041, 0.10511,
                                                                                                              0.10611,
                                                                                                                                            0.1091
                                                                                                                        0.10711,
                                                                                                                                  0.10811,
               0.11111,
                         0.11211,
                                   0.11311, 0.11411, 0.11512, 0.11612, 0.11712,
                                                                                      0.11812, 0.11912,
1,
                  0.12112, 0.12212, 0.12312, 0.12412, 0.12513, 0.12613, 0.12713,
        0.12012,
                                                                                         0.12813,
                                                                                                   0.12913,
                                                                                                              0.13013,
                                                                                                                        0.13113,
                                                                                                                                  0.13213,
                                                                                                                                            0.1331
               0.13514,
                         0.13614,
                                   0.13714, 0.13814, 0.13914, 0.14014, 0.14114,
                                                                                      0.14214, 0.14314,
3,
     0.13413,
                  0.14515, 0.14615, 0.14715, 0.14815, 0.14915, 0.15015, 0.15115,
                                                                                         0.15215,
                                                                                                   0.15315,
                                                                                                              0.15415,
                                                                                                                                  0.15616,
                                                                                                                                             0.1571
        0.14414,
                                                                                                                        0.15516,
     0.15816,
               0.15916,
                       0.16016,
                                   0.16116,
                                           0.16216, 0.16316,
                                                               0.16416, 0.16517,
                                                                                      0.16617,
                                                                                              0.16717,
6,
                  0.16917, 0.17017, 0.17117, 0.17217, 0.17317, 0.17417, 0.17518,
                                                                                                   0.17718,
                                                                                                                                            0.1811
                                                                                         0.17618,
                                                                                                              0.17818,
                                                                                                                        0.17918,
                                                                                                                                  0.18018,
8,
     0.18218,
              0.18318,
                       0.18418,
                                   0.18519, 0.18619, 0.18719, 0.18819, 0.18919, 0.19019, 0.19119,
        0.19219, 0.19319, 0.19419, 0.1952, 0.1962, 0.1972, 0.1982, 0.1992, 0.2002,
                                                                                                                                            0.2052
                                                                                                               0.2022,
                                                                                                                         0.2032,
                                                                                                                                   0.2042,
                        0.20821,
                                   0.20921, 0.21021, 0.21121, 0.21221, 0.21321, 0.21421, 0.21522,
     0.20621,
               0.20721,
                         0.21822, 0.21922, 0.22022, 0.22122, 0.22222, 0.22322, 0.22422, 0.22523,
        0.21622,
                 0.21722,
                                                                                                              0.22623,
                                                                                                                        0.22723,
                                                                                                                                  0.22823,
                                                                                                                                            0.2292
     0.23023,
               0.23123,
                         0.23223,
                                   0.23323,
                                             0.23423, 0.23524,
                                                               0.23624,
                                                                            0.23724,
                                                                                      0.23824, 0.23924,
                                                                                                 0.24925,
                           0.24224,
                                     0.24324, 0.24424, 0.24525, 0.24625,
                                                                               0.24725,
                                                                                         0.24825,
                                                                                                              0.25025,
                                                                                                                                  0.25225,
                                                                                                                                             0.2532
        0.24024,
                  0.24124,
                                                                                                                        0.25125,
     0.25425,
                         0.25626,
                                   0.25726,
                                              0.25826,
                                                        0.25926,
                                                                  0.26026,
                                                                            0.26126,
                                                                                      0.26226,
5,
               0.25526,
```

0	0.26426,				0.26827,					0.27327,	0.27427,	0.27528,	0.27628,	0.2772
8,	0.27828, 0.28829,	0.28929,	0.29029,	0.29129,	0.28228, 0.29229,	0.29329,	0.29429,	0.2953,	0.2963,	0.2973,	0.2983,	0.2993,	0.3003,	0.301
3,	0.3023, 0.31231,	•	0.31431,		0.31632,	0.31732,	0.31832,	0.31932,		•	0.32232,	0.32332,	0.32432,	0.3253
3,	0.32633, 0.33634,	0.33734,	0.33834,		0.34034,	0.34134,	0.34234,			•	0.34635,	0.34735,	0.34835,	0.3493
5,	0.35035, 0.36036,	•	0.36236,		0.36436,	0.35536, 0.36537,				•	0.37037,	0.37137,	0.37237,	0.3733
7,	0.37437, 0.38438,	•	0.38639,		0.38839,	0.38939,		0.38138, 0.39139,			0.39439,	0.3954,	0.3964,	0.397
4,	0.3984, 0.40841,				0.4024, 0.41241,	0.41341,					0.41842,	0.41942,	0.42042,	0.4214
2,	0.43243,	0.43343,	0.43443,		0.42643, 0.43644,	0.43744,	0.43844,				0.44244,	0.44344,	0.44444,	0.4454
5,	0.44645, 0.45646,		0.45846,	0.44945, 0.45946,	0.46046,	0.46146,			,	,	0.46647,	0.46747,	0.46847,	0.4694
7,	0.47047, 0.48048,	0.48148,	0.48248,		0.48448,	0.47548, 0.48549,		0.47748, 0.48749,			0.49049,	0.49149,	0.49249,	0.4934
9,	0.49449, 0.5045,	•		0.4975, 0.50751,		0.50951,		0.5015, 0.51151,			0.51451,	0.51552,	0.51652,	0.5175
2,	0.51852, 0.52853,	0.51952, 0.52953,	0.53053,	0.52152, 0.53153,	0.53253,	0.52352, 0.53353,	0.52452, 0.53453,	0.52553, 0.53554,	0.52653, 0.53654,	0.52753, 0.53754,	0.53854,	0.53954,	0.54054,	0.5415
4,	0.54254, 0.55255,		0.55455,	0.54555, 0.55556,		0.54755, 0.55756,	0.54855, 0.55856,	0.54955, 0.55956,		0.55155, 0.56156,	0.56256,	0.56356,	0.56456,	0.5655
7,	0.56657, 0.57658,	0.56757, 0.57758,		0.56957, 0.57958,		0.57157, 0.58158,	0.57257, 0.58258,	0.57357, 0.58358,	0.57457, 0.58458,	0.57558, 0.58559,	0.58659,	0.58759,	0.58859,	0.5895
9,	0.59059, 0.6006,	0.59159, 0.6016,		0.59359, 0.6036,	0.59459, 0.6046,	0.5956, 0.60561,	0.5966, 0.60661,	0.5976, 0.60761,	0.5986, 0.60861,	0.5996, 0.60961,	0.61061,	0.61161,	0.61261,	0.6136
1,	0.61461, 0.62462,			0.61762, 0.62763,			0.62062, 0.63063,	0.62162, 0.63163,	0.62262, 0.63263,	0.62362, 0.63363,	0.63463,	0.63564,	0.63664,	0.6376
4,	0.63864, 0.64865,	0.63964, 0.64965,	0.64064,	0.64164,	0.64264,	0.64364,	0.64464,	0.64565,	0.64665, 0.65666,	0.64765, 0.65766,	0.65866,	0.65966,	0.66066,	0.6616
6,	0.66266, 0.67267,	0.66366,	0.66466,	0.66567,	0.66667,	0.66767, 0.67768,	0.66867,	0.66967,	0.67067,	0.67167,	0.68268,	0.68368,	0.68468,	0.6856
9,		0.68769,	0.68869,	0.68969,	0.69069, 0.7007,	0.69169,	0.69269,	0.69369,	0.69469,		0.70671,	0.70771,	0.70871,	0.7097
1,		0.71171,	0.71271,	0.71371,	0.71471, 0.72472,	0.71572,	0.71672,		0.71872,	0.71972,	0.73073,	0.73173,	0.73273,	0.7337
3,	0.73473, 0.74474,	0.73574,	0.73674,	0.73774,	0.73874, 0.74875,	0.73974,	0.74074,	0.74174, 0.75175,	0.74274,	0.74374,	0.75475,	0.75576,	0.75676,	0.7577
6,	0.75876,	0.75976,	0.76076,	0.76176,	0.76276,	0.76376,	0.76476,	0.76577,	0.76677,	0.76777, 0.77778,	0.77878,	-	0.78078,	
8,	•	0.78378,	0.78478,	0.78579,		0.78779,	0.78879,	0.78979,	0.79079,	0.79179,	•	0.77978,		0.7817
1,		0.80781,	0.80881,	0.80981,		0.81181,	0.81281,		0.81481,	0.81582,	0.8028,	0.8038,	0.8048,	0.8058
3,		0.83183,	0.83283,	0.83383,		0.83584,	0.83684,	0.83784,	0.83884,	0.82583, 0.83984,	0.82683,	0.82783,	0.82883,	0.8298
5,	0.84084, 0.85485,	0.85586,	0.85686,	0.85786,		0.85986,	0.86086,	0.86186,	0.86286,	0.84985, 0.86386,	0.85085,	0.85185,	0.85285,	0.8538
8,		0.87988,	0.88088,	0.88188,		0.88388,	0.88488,	0.88589,	0.88689,	0.88789,	0.87487,	0.87588,	0.87688,	0.8778
9,	0.88889, 0.9029,	0.9039,	0.9049,	0.90591,	0.89289, 0.90691,	0.90791,	0.90891,	0.90991,	0.91091,	0.91191,	0.8989,	0.8999,	0.9009,	0.901
3,		0.92793,	0.92893,	0.92993,	0.91692, 0.93093,	0.93193,	0.93293,	0.91992, 0.93393,	0.92092, 0.93493,	0.92192, 0.93594,	0.92292,	0.92392,	0.92492,	0.9259
5,	0.93694, 0.95095,	0.95195,	0.95295,	0.95395,		0.95596,	0.95696,	0.94394, 0.95796,	0.94494, 0.95896,	0.94595, 0.95996,	0.94695,	0.94795,	0.94895,	0.9499
7,	0.96096, 0.97497,			0.96396, 0.97798,	0.96496, 0.97898,			0.96797, 0.98198,		0.96997, 0.98398,	0.97097,	0.97197,	0.97297,	0.9739
8,	0.98498, 0.999,	0.98599,	0.98699,	0.98799,	0.98899, 0.024574, 0.03	0.98999,		0.99199, 0,			0.99499,	0.996,	0.997,	0.99
-	[0.031412 [0.050697	, 0.031414	, 0.036393	,,	0, 0,	0, 0,	0], 0],		- •					
	[0.032653	, 0.032653	, 0.052733	,,	0,	0,	0],							

[0.0070671, 0.0070671, 0.011451, ..., 0, [0.055172, 0.055172, 0.12104, ..., 0, 0, 0]]), 'Confidence', 'F1'], [array([0, 0.001001, 0.002002, 0.003003, 0.005005, 0.006006, 0.007007, 0.008008, 0.009009, 0.011011, 0.012012, 0.013013, 0.014014, 0.015015, 0.016016, 0.017017, 0.018018, 0.01001, 0.019019, 0.02002, 0.021021, 0.022022, 0.023023, 0.024024, 0.025025, 0.026026, 0.027027, 0.028028, 0.029029, 0.03003, 0.031031, 0.032032, 0.033033, 0.03703 0.034034. 0.035035, 0.036036. 0.038038, 0.039039, 0.04004, 0.041041, 0.042042, 0.043043, 0.044044, 0.045045, 0.046046, 0.047047, 0.05005, 0.051051, 0.052052, 0.053053, 0.054054, 0.055055, 0.056056, 0.057057, 0.048048, 0.049049, 0.058058, 0.059059, 0.06006, 0.06106 0.063063, 0.064064, 0.065065, 0.066066, 0.067067, 0.068068, 0.069069, 0.07007, 0.071071, 0.062062, 1, 0.072072, 0.073073, 0.074074, 0.075075, 0.076076, 0.077077, 0.078078, 0.079079, 0.08008, 0.081081, 0.082082. 0.083083, 0.084084, 0.08508 0.087087, 0.088088, 0.089089, 0.09009, 0.091091, 0.092092, 0.093093, 0.094094, 0.095095, 0.086086. 0.096096, 0.097097, 0.098098, 0.099099, 0.1001, 0.1011, 0.1021, 0.1031, 0.1041, 0.10511, 0.10611. 0.10711, 0.10811, 0.1091 0.11311, 0.11411, 0.11512, 0.11612, 0.11712, 0.11812, 0.11912, 0.11111, 0.11211, 1, 0.12112, 0.12212, 0.12312, 0.12412, 0.12513, 0.12613, 0.12713, 0.12813, 0.12913. 0.1331 0.13013, 0.13113, 0.13213, 0.13514, 0.13714, 0.13814, 0.13914, 0.14014, 0.14114, 0.14214, 3, 0.13413, 0.13614, 0.14314. 0.14414, 0.14515, 0.14615, 0.14715, 0.14815, 0.14915, 0.15015, 0.15115, 0.15215, 0.15315, 0.15415, 0.15516, 0.15616, 0.1571 0.16016, 0.16116, 0.16216, 0.16316, 0.16416, 0.16517, 0.16617, 0.16717, 6, 0.15816, 0.15916, 0.16817, 0.16917, 0.17017, 0.17117, 0.17217, 0.17317, 0.17417, 0.17518, 0.17618, 0.17718, 0.17818, 0.17918, 0.18018, 0.1811 0.18318, 0.18418, 0.18519, 0.18619, 0.18719, 0.18819, 0.18919, 0.19019, 0.19119, 0.18218. 8, 0.19319, 0.19419, 0.1952, 0.1962, 0.1972, 0.1982, 0.1992, 0.2002, 0.19219, 0.2042. 0.2052 0.2022. 0.2032, 0.20621, 0.20721, 0.20821, 0.20921, 0.21021, 0.21121, 0.21221, 0.21321, 0.21421, 0.21522, 1, 0.21622, 0.21722, 0.21822, 0.21922, 0.22022, 0.22122, 0.22222, 0.22322, 0.22422, 0.22523, 0.22723, 0.22823, 0.2292 0.22623, 0.23223, 0.23323, 0.23423, 0.23524, 0.23624, 0.23724, 0.23824, 0.23924, 3, 0.23023, 0.23123, 0.24124, 0.24024, 0.24224, 0.24324, 0.24424, 0.24525, 0.24625, 0.24725, 0.24825, 0.24925. 0.25025, 0.25125, 0.25225, 0.2532 0.25726, 0.25826, 0.25926, 0.26026, 0.26126, 5, 0.25425, 0.25526, 0.25626, 0.26226, 0.26326, 0.26527, 0.26627, 0.26727, 0.26827, 0.26927, 0.27027, 0.27127, 0.27227, 0.27327, 0.27427, 0.27528, 0.27628, 0.2772 0.28228, 0.28328, 0.28428, 0.28529, 0.28629, 0.28729, 8, 0.27828, 0.27928, 0.28028, 0.28128, 0.28929, 0.29029, 0.29129, 0.29229, 0.29329, 0.29429, 0.2953, 0.2963, 0.2973, 0.28829. 0.2983. 0.2993, 0.3003, 0.301 3, 0.3023. 0.3033. 0.3043. 0.30531, 0.30631, 0.30731, 0.30831, 0.30931, 0.31031, 0.31131, 0.31331, 0.31431, 0.31231, 0.31532, 0.31632, 0.31732, 0.31832, 0.31932, 0.32032, 0.32132. 0.32232, 0.32332, 0.32432, 0.3253 0.33033, 0.33133, 0.33233, 0.33333, 0.32733, 0.32833, 0.32933, 0.33433, 0.33534, 0.32633, 3, 0.34334, 0.33834, 0.33934, 0.34234, 0.34434, 0.33734, 0.34034, 0.34134, 0.34535. 0.33634, 0.34635, 0.34735, 0.34835, 0.3493 0.35135, 0.35035, 0.35235, 0.35335, 0.35435, 0.35536, 0.35636, 0.35736, 0.35836, 0.35936, 5, 0.36036, 0.36136, 0.36236, 0.36336, 0.36436, 0.36537, 0.36637, 0.36737, 0.36837, 0.36937, 0.37037, 0.37137, 0.37237, 0.3733 0.37938, 0.37437, 0.37538, 0.37638, 0.37738, 0.37838, 0.38038, 0.38138, 0.38238, 0.38338, 7, 0.38739, 0.38438, 0.38539, 0.38639, 0.38839, 0.38939, 0.39039, 0.39139, 0.39239, 0.39339. 0.3954, 0.397 0.39439. 0.3964, 0.3984. 0.3994, 0.4004, 0.4014, 0.4024, 0.4034, 0.4044, 0.40541, 0.40641, 0.40741. 0.40841. 0.40941, 0.41041, 0.41141, 0.41241, 0.41341, 0.41441, 0.41542, 0.41642, 0.41842. 0.41942. 0.42042. 0.4214 0.42543, 0.42643, 0.42743, 0.42843, 0.42943, 0.43043, 0.43143, 2, 0.42242, 0.42342, 0.42442, 0.43243, 0.43343, 0.43443, 0.43544, 0.43644, 0.43744, 0.43844, 0.43944, 0.44044, 0.44144, 0.44244, 0.44344, 0.44444, 0.4454 0.44845, 0.44645, 0.44745, 0.44945, 0.45045, 0.45145, 0.45245, 0.45345, 0.45445, 0.45546, 5, 0.45846, 0.45946, 0.46446, 0.45646, 0.46046, 0.46146, 0.46246, 0.46346, 0.45746, 0.46547, 0.46647, 0.46747, 0.46847, 0.4694 0.47047, 0.47147, 0.47247, 0.47347, 0.47447, 0.47548, 0.47648, 0.47748, 0.47848, 0.47948, 7, 0.48048, 0.48148, 0.48248, 0.48348, 0.48448, 0.48549, 0.48649, 0.48749, 0.48849, 0.48949, 0.49049, 0.49249, 0.4934 0.49149, 9, 0.49449, 0.4955, 0.4965, 0.4975, 0.4985, 0.4995, 0.5005, 0.5015, 0.5025, 0.5035, 0.50751, 0.50651, 0.50851, 0.50551, 0.51051, 0.5045, 0.50951, 0.51151, 0.51251, 0.51351, 0.51451, 0.51552, 0.51652, 0.5175 0.52352, 0.52452, 2, 0.51852, 0.51952, 0.52052, 0.52152, 0.52252, 0.52553, 0.52653, 0.52753, 0.53654, 0.52853, 0.52953, 0.53053, 0.53153, 0.53253, 0.53353, 0.53453, 0.53554, 0.53754, 0.53854, 0.53954, 0.54054, 0.5415 0.54254, 0.54354, 0.54454, 0.54555, 0.54655, 0.54755, 0.54855, 0.54955, 0.55055, 4, 0.55255, 0.55355, 0.55455, 0.55556, 0.55656, 0.55756, 0.55856, 0.55956, 0.56056, 0.56156, 0.56256, 0.56456, 0.5655 0.56356, 7, 0.56657, 0.56757, 0.56857, 0.56957, 0.57057, 0.57157, 0.57257, 0.57357, 0.57457, 0.57558, 0.57858, 0.58458, 0.57958, 0.58058, 0.58158, 0.58258, 0.58358, 0.58559, 0.5895 0.57658, 0.57758, 0.58659, 0.58759, 0.58859, 9, 0.59059, 0.59159, 0.59259, 0.59359, 0.59459, 0.5956, 0.5966, 0.5976, 0.5986, 0.5996, 0.6016, 0.6026, 0.6046, 0.60561, 0.60661, 0.60761, 0.60861, 0.60961, 0.6006, 0.6036, 0.61261, 0.6136 0.61061, 0.61161, 0.61461, 0.61562, 0.61662, 0.61762, 0.61862, 0.61962, 0.62062, 0.62162, 0.62262, 0.62362, 1, 0.62963, 0.62663, 0.63063, 0.63363, 0.63463, 0.62462, 0.62563, 0.62763, 0.62863, 0.63163, 0.63263, 0.63564, 0.63664, 0.6376 0.63864, 0.63964, 0.64064, 0.64164, 0.64264, 0.64364, 0.64464, 0.64565, 0.64665, 0.64765, 0.65465, 0.64965, 0.65065, 0.65365, 0.65566, 0.64865, 0.65165, 0.65265, 0.65666, 0.65766, 0.65866, 0.65966, 0.66066, 0.6616 0.66466, 0.66967, 0.66266, 0.66366, 0.66567, 0.66667, 0.66767, 0.66867, 0.67067, 0.67167, 6, 0.67768, 0.67868, 0.67968, 0.68068, 0.68268, 0.6856 0.67367, 0.67467, 0.67568, 0.67668, 0.68368, 0.68468, 0.68869, 9, 0.68669, 0.68769, 0.68969, 0.69069, 0.69169, 0.69269, 0.69369, 0.69469, 0.6957, 0.6977, 0.6987, 0.6997, 0.7007, 0.7017, 0.7027, 0.7037, 0.7047, 0.7097 0.6967, 0.70571, 0.70671, 0.70771, 0.70871, 0.71171, 0.71371, 0.71471, 0.71572, 0.71672, 0.71772, 0.71872, 0.71972, 0.71071, 0.71271, 0.72472, 0.72573, 0.72673, 0.72773, 0.72072, 0.72172, 0.72272, 0.72372, 0.72873, 0.72973, 0.73073, 0.73173, 0.73273, 0.7337 0.73674, 0.74174, 0.73473, 0.73574, 0.73774, 0.73874, 0.73974, 0.74074, 0.74274, 0.74374, 3, 0.74875, 0.75375, 0.74575, 0.74675, 0.74775, 0.74975, 0.75075, 0.75175, 0.75275, 0.75475, 0.75676, 0.7577 0.74474, 0.75576, 0.75876, 0.75976, 0.76076, 0.76176, 0.76276, 0.76376, 0.76476, 0.76577, 0.76677, 0.76777, 6,

```
0.77578,
                  0.76977,
                            0.77077, 0.77177, 0.77277, 0.77377, 0.77477,
                                                                                         0.77678,
                                                                                                   0.77778.
                                                                                                             0.77878,
                                                                                                                       0.77978,
                                                                                                                                 0.78078,
                                                                                                                                            0.7817
     0.78278, 0.78378, 0.78478, 0.78579, 0.78679, 0.78779, 0.78879, 0.78979, 0.79079, 0.79179,
8,
        0.79279, 0.79379, 0.79479, 0.7958, 0.7968, 0.7978, 0.7988, 0.7998, 0.8008, 0.8018,
                                                                                                                        0.8038,
                                                                                                                                  0.8048,
                                                                                                                                           0.8058
                                                                                                              0.8028,
     0.80681, 0.80781, 0.80881, 0.80981, 0.81081, 0.81181, 0.81281, 0.81381, 0.81481, 0.81582,
1,
        0.81682, 0.81782, 0.81882, 0.81982, 0.82082, 0.82182, 0.82282, 0.82382, 0.82482, 0.82583,
                                                                                                                                 0.82883,
                                                                                                                                            0.8298
                                                                                                             0.82683,
                                                                                                                       0.82783,
              0.83183, 0.83283, 0.83383, 0.83483, 0.83584, 0.83684, 0.83784, 0.83884, 0.83984,
     0.83083,
3,
                  0.84184, 0.84284, 0.84384, 0.84484, 0.84585, 0.84685, 0.84785, 0.84885, 0.84985,
        0.84084,
                                                                                                             0.85085,
                                                                                                                       0.85185,
                                                                                                                                 0.85285,
                                                                                                                                            0.8538
                         0.85686, 0.85786, 0.85886, 0.85986, 0.86086, 0.86186, 0.86286, 0.86386,
5,
     0.85485,
               0.85586,
        0.86486,
                  0.86587, 0.86687, 0.86787, 0.86887, 0.86987, 0.87087, 0.87187, 0.87287, 0.87387,
                                                                                                             0.87487.
                                                                                                                       0.87588,
                                                                                                                                 0.87688,
                                                                                                                                           0.8778
                         0.88088, 0.88188, 0.88288, 0.88388, 0.88488, 0.88589, 0.88689, 0.88789,
     0.87888.
               0.87988,
8,
        0.88889,
               0.88989, 0.89089, 0.89189, 0.89289, 0.89389, 0.89489, 0.8959, 0.8969, 0.8979,
                                                                                                              0.8989.
                                                                                                                        0.8999,
                                                                                                                                  0.9009,
                                                                                                                                            0.901
                         0.9049, 0.90591, 0.90691, 0.90791, 0.90891, 0.90991, 0.91091, 0.91191,
9,
      0.9029,
                0.9039,
                  0.91391, 0.91491, 0.91592, 0.91692, 0.91792, 0.91892, 0.91992, 0.92092, 0.92192,
                                                                                                             0.92292,
                                                                                                                                 0.92492,
                                                                                                                                            0.9259
                                                                                                                       0.92392,
               0.92793, 0.92893, 0.92993, 0.93093, 0.93193, 0.93293, 0.93393, 0.93493, 0.93594,
3,
        0.93694, 0.93794, 0.93894, 0.93994, 0.94094, 0.94194, 0.94294, 0.94394, 0.94494, 0.94595,
                                                                                                             0.94695,
                                                                                                                       0.94795,
                                                                                                                                 0.94895,
                                                                                                                                            0.9499
             0.95195, 0.95295, 0.95395, 0.95495, 0.95596, 0.95696, 0.95796, 0.95896, 0.95996,
5,
     0.95095,
        0.96096, 0.96196, 0.96296, 0.96396, 0.96496, 0.96597, 0.96697, 0.96797, 0.96897, 0.96997,
                                                                                                             0.97097,
                                                                                                                       0.97197,
                                                                                                                                 0.97297,
                                                                                                                                           0.9739
     0.97497.
              0.97598, 0.97698, 0.97798, 0.97898, 0.97998, 0.98098, 0.98198, 0.98298, 0.98398,
7,
                            0.98699, 0.98799, 0.98899, 0.98999,
                                                                     0.99099,
                                                                               0.99199,
                                                                                         0.99299.
                                                                                                  0.99399.
        0.98498.
                  0.98599.
                                                                                                             0.99499.
                                                                                                                         0.996.
                                                                                                                                   0.997,
                                                                                                                                             0.99
8,
       0.999.
                  1]), array([[ 0.012442, 0.012442, 0.013339, ...,
                                                                    1,
                                                                               1,
                                                                                           1],
     [ 0.015965,
                  0.015967, 0.018547, ...,
                                                                    1],
                                               1,
                                                        1,
     [ 0.026042,
                            0.039974, ...,
                                                                    1],
                  0.026042,
                                                1,
                                                          1,
                           0.027081, ...,
     [ 0.016598,
                  0.016598,
                                               1,
                                                          1,
                                                                    1],
                                         1,
                 0.0035587, 0.0057917, ...,
     [ 0.0035587,
                                                          1,
                                                                    1],
                 0.028369, 0.064418, ...,
                                                                    1]]), 'Confidence', 'Precision'], [array([
     [ 0.028369,
                                                          1,
                                                                                                            0, 0.001001, 0.002002, 0.003003,
0.004004, 0.005005, 0.006006, 0.007007, 0.008008, 0.009009, 0.01001, 0.011011, 0.012012, 0.013013, 0.014014, 0.015015, 0.016016, 0.017017, 0.01
8018, 0.019019, 0.02002, 0.021021, 0.022022, 0.023023, 0.024024, 0.025025, 0.026026, 0.027027, 0.028028, 0.029029, 0.03003, 0.031031, 0.032032, 0.033033,
                                                                                                            0.034034.
                                                                                                                       0.035035,
                                                                                                                                 0.036036,
                                                                                                                                           0.03703
    0.038038, 0.039039, 0.04004, 0.041041, 0.042042, 0.043043, 0.044044, 0.045045, 0.046046, 0.047047,
                 0.049049, 0.05005, 0.051051, 0.052052, 0.053053, 0.054054, 0.055055, 0.056056, 0.057057,
       0.048048,
                                                                                                            0.058058.
                                                                                                                       0.059059,
                                                                                                                                 0.06006,
                                                                                                                                           0.06106
    0.062062, 0.063063, 0.064064, 0.065065, 0.066066, 0.067067, 0.068068, 0.069069, 0.07007, 0.071071,
       0.072072, 0.073073, 0.074074, 0.075075, 0.076076, 0.077077, 0.078078, 0.079079, 0.08008, 0.081081,
                                                                                                            0.082082,
                                                                                                                       0.083083,
                                                                                                                                 0.084084,
                                                                                                                                           0.08508
    0.086086, 0.087087, 0.088088, 0.089089, 0.09009, 0.091091, 0.092092, 0.093093, 0.094094, 0.095095,
5,
       0.096096, 0.097097, 0.098098, 0.099099, 0.1001, 0.1011, 0.1021, 0.1031, 0.1041, 0.10511,
                                                                                                                                           0.1091
                                                                                                             0.10611.
                                                                                                                       0.10711,
                                                                                                                                 0.10811,
              0.1111, 0.11211, 0.11311, 0.11411, 0.11512, 0.11612, 0.11712, 0.11812, 0.11912,
1,
        0.12012, 0.12112, 0.12212, 0.12312, 0.12412, 0.12513, 0.12613, 0.12713, 0.12813, 0.12913,
                                                                                                             0.13013.
                                                                                                                       0.13113,
                                                                                                                                 0.13213.
                                                                                                                                           0.1331
     0.13413, 0.13514, 0.13614, 0.13714, 0.13814, 0.13914, 0.14014, 0.14114, 0.14214, 0.14314,
3,
        0.14414, 0.14515, 0.14615, 0.14715, 0.14815, 0.14915, 0.15015, 0.15115, 0.15215, 0.15315,
                                                                                                             0.15415,
                                                                                                                       0.15516,
                                                                                                                                 0.15616,
                                                                                                                                           0.1571
     0.15816,
            0.15916, 0.16016, 0.16116, 0.16216, 0.16316, 0.16416, 0.16517, 0.16617, 0.16717,
6,
        0.16817, 0.16917, 0.17017, 0.17117, 0.17217, 0.17317, 0.17417, 0.17518, 0.17618, 0.17718,
                                                                                                             0.17818,
                                                                                                                       0.17918,
                                                                                                                                 0.18018,
                                                                                                                                           0.1811
     0.18218, 0.18318,
                         0.18418,
                                   0.18519, 0.18619, 0.18719, 0.18819, 0.18919, 0.19019, 0.19119,
8,
        0.19219, 0.19319, 0.19419, 0.1952, 0.1962, 0.1972, 0.1982, 0.1992, 0.2002, 0.2012,
                                                                                                                                           0.2052
                                                                                                              0.2022,
                                                                                                                        0.2032,
                                                                                                                                  0.2042,
                                   0.20921, 0.21021, 0.21121, 0.21221, 0.21321, 0.21421, 0.21522,
     0.20621, 0.20721, 0.20821,
1,
        0.21622, 0.21722, 0.21822, 0.21922, 0.22022, 0.22122, 0.22222, 0.22322, 0.22422, 0.22523,
                                                                                                                                           0.2292
                                                                                                             0.22623,
                                                                                                                       0.22723.
                                                                                                                                 0.22823.
              0.23123, 0.23223, 0.23323,
                                           0.23423, 0.23524, 0.23624, 0.23724, 0.23824, 0.23924,
3,
     0.23023,
        0.24024, 0.24124, 0.24224, 0.24324, 0.24424, 0.24525, 0.24625, 0.24725, 0.24825, 0.24925,
                                                                                                             0.25025,
                                                                                                                       0.25125,
                                                                                                                                 0.25225,
                                                                                                                                           0.2532
             0.25526,
                       0.25626, 0.25726, 0.25826, 0.25926, 0.26026, 0.26126, 0.26226, 0.26326,
5,
        0.26426, 0.26527, 0.26627, 0.26727, 0.26827, 0.26927, 0.27027, 0.27127, 0.27227, 0.27327,
                                                                                                             0.27427,
                                                                                                                       0.27528,
                                                                                                                                 0.27628,
                                                                                                                                           0.2772
8,
     0.27828,
             0.27928, 0.28028, 0.28128, 0.28228, 0.28328, 0.28428, 0.28529, 0.28629, 0.28729,
        0.28829, 0.28929, 0.29029, 0.29129, 0.29229, 0.29329, 0.29429, 0.2953, 0.2963, 0.2973,
                                                                                                                        0.2993,
                                                                                                                                            0.301
                                                                                                              0.2983,
                                                                                                                                  0.3003,
      0.3023,
                0.3033,
                         0.3043, 0.30531, 0.30631, 0.30731, 0.30831, 0.30931, 0.31031, 0.31131,
3,
        0.31231,
                          0.31431, 0.31532,
                                              0.31632, 0.31732, 0.31832, 0.31932, 0.32032,
                                                                                                0.32132,
                  0.31331,
                                                                                                             0.32232,
                                                                                                                       0.32332,
                                                                                                                                 0.32432,
                                                                                                                                           0.3253
                                             0.33033, 0.33133, 0.33233, 0.33333, 0.33433,
3,
               0.32733,
                         0.32833,
                                   0.32933,
        0.33634,
                  0.33734, 0.33834, 0.33934, 0.34034, 0.34134, 0.34234, 0.34334,
                                                                                         0.34434,
                                                                                                  0.34535,
                                                                                                             0.34635,
                                                                                                                       0.34735,
                                                                                                                                 0.34835,
                                                                                                                                           0.3493
               0.35135,
                         0.35235,
                                   0.35335,
                                           0.35435, 0.35536, 0.35636, 0.35736, 0.35836,
                                                                                               0.35936,
5,
     0.35035,
        0.36036,
                  0.36136, 0.36236, 0.36336, 0.36436, 0.36537, 0.36637, 0.36737, 0.36837,
                                                                                                  0.36937,
                                                                                                             0.37037,
                                                                                                                       0.37137,
                                                                                                                                 0.37237,
                                                                                                                                           0.3733
                                           0.37838,
                                                               0.38038, 0.38138,
                                                     0.37938,
     0.37437,
               0.37538,
                         0.37638,
                                   0.37738,
                                                                                   0.38238,
                                                                                              0.38338,
7,
        0.38438,
                  0.38539, 0.38639, 0.38739, 0.38839, 0.38939, 0.39039, 0.39139, 0.39239,
                                                                                                  0.39339,
                                                                                                             0.39439,
                                                                                                                                  0.3964,
                                                                                                                                            0.397
                                                                                                                        0.3954,
                                           0.4024,
                                                        0.4034,
4,
                0.3994,
                          0.4004,
                                   0.4014,
                                                                  0.4044, 0.40541, 0.40641, 0.40741,
        0.40841, 0.40941, 0.41041, 0.41141, 0.41241, 0.41341, 0.41441, 0.41542, 0.41642, 0.41742,
                                                                                                                                           0.4214
                                                                                                             0.41842,
                                                                                                                       0.41942,
                                                                                                                                 0.42042,
                       0.42442, 0.42543, 0.42643, 0.42743, 0.42843, 0.42943, 0.43043, 0.43143,
     0.42242,
              0.42342,
               0.43343, 0.43443, 0.43544, 0.43644, 0.43744, 0.43844, 0.43944, 0.44044, 0.44144,
        0.43243,
                                                                                                             0.44244,
                                                                                                                       0.44344,
                                                                                                                                 0.44444,
                                                                                                                                           0.4454
     0.44645,
               0.44745,
                         0.44845,
                                   0.44945, 0.45045, 0.45145,
                                                               0.45245,
                                                                           0.45345, 0.45445, 0.45546,
5,
                 0.45746, 0.45846, 0.45946, 0.46046, 0.46146, 0.46246, 0.46346, 0.46446,
                                                                                                0.46547,
                                                                                                                                           0.4694
                                                                                                             0.46647,
                                                                                                                       0.46747,
                                                                                                                                 0.46847,
        0.45646,
                                             0.47447,
7,
     0.47047,
               0.47147,
                         0.47247,
                                   0.47347,
                                                       0.47548,
                                                                  0.47648,
                                                                            0.47748,
                                                                                      0.47848,
```

```
0.49249,
                                                                                                                                                                                               0.4934
            0.48048,
                         0.48148,
                                       0.48248,
                                                     0.48348,
                                                                   0.48448,
                                                                                0.48549,
                                                                                              0.48649,
                                                                                                            0.48749,
                                                                                                                          0.48849,
                                                                                                                                        0.48949,
                                                                                                                                                     0.49049,
                                                                                                                                                                   0.49149,
       0.49449,
                                                                                                         0.5015,
9,
                      0.4955,
                                    0.4965,
                                                 0.4975,
                                                               0.4985,
                                                                             0.4995,
                                                                                           0.5005,
                                                                                                                      0.5025,
                                                                                                                                    0.5035,
                                                                                0.50951,
                                                                                                            0.51151,
            0.5045,
                         0.50551,
                                       0.50651,
                                                    0.50751,
                                                                  0.50851,
                                                                                              0.51051,
                                                                                                                         0.51251,
                                                                                                                                       0.51351,
                                                                                                                                                     0.51451,
                                                                                                                                                                   0.51552,
                                                                                                                                                                                 0.51652,
                                                                                                                                                                                               0.5175
2,
       0.51852,
                     0.51952,
                                  0.52052,
                                                0.52152,
                                                              0.52252,
                                                                            0.52352,
                                                                                          0.52452,
                                                                                                       0.52553,
                                                                                                                     0.52653,
                                                                                                                                   0.52753,
           0.52853,
                         0.52953,
                                       0.53053,
                                                    0.53153,
                                                                  0.53253,
                                                                                0.53353,
                                                                                              0.53453,
                                                                                                            0.53554,
                                                                                                                          0.53654,
                                                                                                                                       0.53754.
                                                                                                                                                     0.53854,
                                                                                                                                                                   0.53954,
                                                                                                                                                                                 0.54054,
                                                                                                                                                                                               0.5415
       0.54254,
                     0.54354,
                                  0.54454,
                                                0.54555,
                                                              0.54655,
                                                                            0.54755,
                                                                                          0.54855,
                                                                                                       0.54955,
                                                                                                                     0.55055,
                                                                                                                                   0.55155,
4,
                                                                                                            0.55956,
           0.55255,
                         0.55355,
                                       0.55455,
                                                     0.55556,
                                                                  0.55656,
                                                                                0.55756,
                                                                                              0.55856,
                                                                                                                          0.56056,
                                                                                                                                        0.56156,
                                                                                                                                                                                               0.5655
                                                                                                                                                     0.56256,
                                                                                                                                                                   0.56356,
                                                                                                                                                                                 0.56456,
7,
       0.56657,
                     0.56757,
                                  0.56857,
                                                0.56957,
                                                              0.57057,
                                                                            0.57157,
                                                                                          0.57257,
                                                                                                       0.57357,
                                                                                                                     0.57457,
                                                                                                                                   0.57558,
           0.57658,
                                       0.57858,
                                                    0.57958,
                                                                  0.58058,
                                                                                0.58158,
                                                                                              0.58258,
                                                                                                            0.58358,
                                                                                                                          0.58458,
                                                                                                                                        0.58559,
                                                                                                                                                                                 0.58859,
                                                                                                                                                                                               0.5895
                         0.57758,
                                                                                                                                                     0.58659,
                                                                                                                                                                   0.58759,
                                  0.59259,
                                                0.59359,
9,
       0.59059,
                     0.59159,
                                                              0.59459,
                                                                             0.5956,
                                                                                           0.5966,
                                                                                                         0.5976,
                                                                                                                      0.5986,
                                                                                                                                    0.5996,
            0.6006,
                                                                                                            0.60761,
                          0.6016,
                                        0.6026,
                                                      0.6036,
                                                                                0.60561,
                                                                                              0.60661,
                                                                                                                          0.60861,
                                                                                                                                        0.60961,
                                                                                                                                                     0.61061,
                                                                                                                                                                                 0.61261,
                                                                                                                                                                                               0.6136
                                                                   0.6046,
                                                                                                                                                                   0.61161,
       0.61461,
                     0.61562,
                                  0.61662,
                                                0.61762,
                                                              0.61862,
                                                                            0.61962,
                                                                                          0.62062,
                                                                                                       0.62162,
                                                                                                                     0.62262,
                                                                                                                                   0.62362,
1,
           0.62462,
                         0.62563,
                                       0.62663,
                                                    0.62763,
                                                                  0.62863,
                                                                                0.62963,
                                                                                              0.63063,
                                                                                                            0.63163,
                                                                                                                          0.63263,
                                                                                                                                        0.63363,
                                                                                                                                                     0.63463,
                                                                                                                                                                   0.63564,
                                                                                                                                                                                 0.63664,
                                                                                                                                                                                               0.6376
4,
       0.63864,
                     0.63964,
                                  0.64064,
                                                0.64164,
                                                              0.64264,
                                                                            0.64364,
                                                                                          0.64464,
                                                                                                       0.64565,
                                                                                                                     0.64665,
                                                                                                                                   0.64765,
                                                                  0.65265,
                                                                                0.65365,
                                                                                                                         0.65666,
                                                                                                                                                     0.65866,
                                                                                                                                                                                 0.66066,
                                                                                                                                                                                               0.6616
           0.64865,
                         0.64965,
                                       0.65065,
                                                    0.65165,
                                                                                              0.65465,
                                                                                                            0.65566,
                                                                                                                                       0.65766,
                                                                                                                                                                   0.65966,
6,
       0.66266,
                     0.66366,
                                  0.66466,
                                                0.66567,
                                                              0.66667,
                                                                            0.66767,
                                                                                          0.66867,
                                                                                                       0.66967,
                                                                                                                     0.67067,
                                                                                                                                   0.67167,
           0.67267,
                         0.67367,
                                       0.67467,
                                                    0.67568,
                                                                  0.67668,
                                                                                0.67768,
                                                                                              0.67868,
                                                                                                            0.67968,
                                                                                                                         0.68068,
                                                                                                                                       0.68168,
                                                                                                                                                     0.68268,
                                                                                                                                                                   0.68368,
                                                                                                                                                                                 0.68468,
                                                                                                                                                                                               0.6856
9,
       0.68669,
                     0.68769,
                                  0.68869,
                                                0.68969,
                                                              0.69069,
                                                                            0.69169,
                                                                                          0.69269,
                                                                                                       0.69369,
                                                                                                                     0.69469,
                                                                                                                                    0.6957,
                                                                                               0.7027,
                          0.6977,
                                                                                 0.7017,
                                                                                                             0.7037,
                                                                                                                                                                                               0.7097
            0.6967,
                                        0.6987,
                                                      0.6997,
                                                                    0.7007,
                                                                                                                           0.7047,
                                                                                                                                        0.70571.
                                                                                                                                                     0.70671,
                                                                                                                                                                   0.70771,
                                                                                                                                                                                 0.70871,
       0.71071,
                     0.71171,
                                  0.71271,
                                                0.71371,
                                                              0.71471,
                                                                            0.71572,
                                                                                          0.71672,
                                                                                                       0.71772,
                                                                                                                     0.71872,
                                                                                                                                   0.71972,
1,
                                                                                                                                       0.72973,
                                                                                                                                                                                               0.7337
           0.72072,
                         0.72172,
                                       0.72272,
                                                    0.72372,
                                                                  0.72472,
                                                                                0.72573,
                                                                                              0.72673,
                                                                                                            0.72773,
                                                                                                                         0.72873,
                                                                                                                                                     0.73073,
                                                                                                                                                                   0.73173,
                                                                                                                                                                                 0.73273,
       0.73473,
                     0.73574,
                                  0.73674,
                                                0.73774,
                                                              0.73874,
                                                                            0.73974,
                                                                                          0.74074,
                                                                                                       0.74174,
                                                                                                                     0.74274,
                                                                                                                                   0.74374,
3,
                         0.74575,
                                       0.74675,
                                                    0.74775,
                                                                                0.74975,
                                                                                              0.75075,
                                                                                                            0.75175,
                                                                                                                                       0.75375,
                                                                                                                                                                                               0.7577
           0.74474,
                                                                  0.74875,
                                                                                                                          0.75275,
                                                                                                                                                     0.75475,
                                                                                                                                                                   0.75576,
                                                                                                                                                                                 0.75676,
6,
       0.75876,
                     0.75976,
                                  0.76076,
                                                0.76176,
                                                              0.76276,
                                                                            0.76376,
                                                                                          0.76476,
                                                                                                       0.76577,
                                                                                                                     0.76677,
                                                                                                                                   0.76777,
                                                    0.77177,
                                                                                              0.77477,
           0.76877,
                         0.76977,
                                       0.77077,
                                                                  0.77277,
                                                                                0.77377,
                                                                                                            0.77578,
                                                                                                                          0.77678,
                                                                                                                                        0.77778,
                                                                                                                                                     0.77878,
                                                                                                                                                                   0.77978,
                                                                                                                                                                                 0.78078,
                                                                                                                                                                                               0.7817
       0.78278,
                     0.78378,
                                  0.78478,
                                                0.78579,
                                                              0.78679,
                                                                            0.78779,
                                                                                          0.78879,
                                                                                                       0.78979,
                                                                                                                     0.79079,
                                                                                                                                   0.79179,
8,
           0.79279,
                         0.79379,
                                       0.79479,
                                                      0.7958,
                                                                    0.7968,
                                                                                 0.7978,
                                                                                               0.7988,
                                                                                                             0.7998,
                                                                                                                           0.8008,
                                                                                                                                        0.8018.
                                                                                                                                                      0.8028,
                                                                                                                                                                    0.8038,
                                                                                                                                                                                  0.8048,
                                                                                                                                                                                               0.8058
       0.80681.
                     0.80781,
                                  0.80881,
                                                0.80981,
                                                              0.81081,
                                                                            0.81181,
                                                                                          0.81281,
                                                                                                       0.81381,
                                                                                                                     0.81481,
                                                                                                                                   0.81582.
1,
           0.81682,
                                                    0.81982,
                                                                                0.82182,
                                                                                                                                       0.82583,
                                                                                                                                                                                 0.82883,
                                                                                                                                                                                               0.8298
                         0.81782,
                                       0.81882,
                                                                  0.82082,
                                                                                              0.82282,
                                                                                                            0.82382,
                                                                                                                          0.82482,
                                                                                                                                                     0.82683,
                                                                                                                                                                   0.82783,
                                                                                          0.83684,
       0.83083,
                     0.83183,
                                  0.83283,
                                                0.83383,
                                                              0.83483,
                                                                            0.83584,
                                                                                                       0.83784,
                                                                                                                     0.83884,
                                                                                                                                   0.83984,
3,
                                                                                                                                                                   0.85185,
           0.84084,
                         0.84184,
                                       0.84284,
                                                     0.84384,
                                                                  0.84484,
                                                                                0.84585,
                                                                                              0.84685,
                                                                                                            0.84785,
                                                                                                                          0.84885,
                                                                                                                                        0.84985,
                                                                                                                                                     0.85085,
                                                                                                                                                                                 0.85285,
                                                                                                                                                                                               0.8538
       0.85485,
                     0.85586,
                                  0.85686,
                                                0.85786,
                                                              0.85886,
                                                                            0.85986,
                                                                                          0.86086,
                                                                                                       0.86186,
                                                                                                                     0.86286,
                                                                                                                                   0.86386,
5,
                                                                                                                                        0.87387,
                                                                                                                                                                                 0.87688,
                                                                                                                                                                                               0.8778
           0.86486,
                         0.86587,
                                       0.86687,
                                                    0.86787,
                                                                  0.86887,
                                                                                0.86987,
                                                                                              0.87087,
                                                                                                            0.87187,
                                                                                                                         0.87287,
                                                                                                                                                     0.87487,
                                                                                                                                                                   0.87588,
       0.87888,
                     0.87988,
                                  0.88088,
                                                0.88188,
                                                              0.88288,
                                                                            0.88388,
                                                                                          0.88488,
                                                                                                       0.88589,
                                                                                                                     0.88689,
                                                                                                                                   0.88789,
8,
           0.88889,
                         0.88989,
                                       0.89089,
                                                    0.89189,
                                                                  0.89289,
                                                                                0.89389,
                                                                                              0.89489,
                                                                                                             0.8959,
                                                                                                                           0.8969,
                                                                                                                                        0.8979,
                                                                                                                                                      0.8989,
                                                                                                                                                                    0.8999,
                                                                                                                                                                                  0.9009,
                                                                                                                                                                                                0.901
9,
        0.9029,
                      0.9039,
                                   0.9049,
                                                0.90591,
                                                              0.90691,
                                                                            0.90791,
                                                                                          0.90891,
                                                                                                       0.90991,
                                                                                                                     0.91091,
                                                                                                                                   0.91191.
                                                                                0.91792,
                                                                                                                                                                                               0.9259
           0.91291,
                         0.91391,
                                       0.91491,
                                                    0.91592,
                                                                  0.91692,
                                                                                              0.91892,
                                                                                                            0.91992,
                                                                                                                          0.92092,
                                                                                                                                        0.92192.
                                                                                                                                                     0.92292,
                                                                                                                                                                   0.92392,
                                                                                                                                                                                 0.92492,
3,
       0.92693,
                     0.92793,
                                  0.92893,
                                                0.92993,
                                                              0.93093,
                                                                            0.93193,
                                                                                          0.93293,
                                                                                                       0.93393,
                                                                                                                     0.93493,
                                                                                                                                   0.93594,
                                                    0.93994,
                                                                  0.94094,
                                                                                              0.94294,
           0.93694,
                         0.93794,
                                       0.93894,
                                                                                0.94194,
                                                                                                            0.94394,
                                                                                                                         0.94494,
                                                                                                                                       0.94595,
                                                                                                                                                     0.94695,
                                                                                                                                                                   0.94795,
                                                                                                                                                                                 0.94895,
                                                                                                                                                                                               0.9499
       0.95095,
                     0.95195,
                                  0.95295,
                                                0.95395,
                                                              0.95495,
                                                                            0.95596,
                                                                                          0.95696,
                                                                                                       0.95796,
                                                                                                                     0.95896,
                                                                                                                                   0.95996,
5,
                                                                  0.96496,
           0.96096,
                         0.96196,
                                       0.96296,
                                                    0.96396,
                                                                                0.96597,
                                                                                              0.96697,
                                                                                                            0.96797,
                                                                                                                          0.96897,
                                                                                                                                       0.96997,
                                                                                                                                                     0.97097,
                                                                                                                                                                   0.97197,
                                                                                                                                                                                 0.97297,
                                                                                                                                                                                               0.9739
                                                                            0.97998,
7,
       0.97497,
                     0.97598,
                                  0.97698,
                                                0.97798,
                                                              0.97898,
                                                                                          0.98098,
                                                                                                       0.98198,
                                                                                                                     0.98298,
                                                                                                                                   0.98398,
           0.98498,
                                                                  0.98899,
                                                                                0.98999,
                                                                                              0.99099,
                                                                                                                                        0.99399,
                                                                                                                                                                                   0.997,
                                                                                                                                                                                                 0.99
                         0.98599,
                                       0.98699,
                                                    0.98799,
                                                                                                            0.99199,
                                                                                                                          0.99299,
                                                                                                                                                     0.99499,
                                                                                                                                                                     0.996,
8,
         0.999,
                           1]), array([[
                                              0.9881,
                                                            0.9881,
                                                                         0.97619, ...,
                                                                                                  0,
                                                                                                                              0],
                                                                                                                0,
            0.96605,
                          0.96605,
                                        0.96296, ...,
                                                                                             0],
                                                                 0,
                                                                               0,
                                        0.95238, ...,
            0.95238,
                          0.95238,
                                                                               0,
                                                                                             0],
                                                                 0,
                                                                                             0],
                                                                               0,
                  1,
                                1,
                                              1, ...,
                                                                 0,
                                            0.5, ...,
                              0.5,
                                                                               0,
                                                                                             0],
                 0.5,
                                                                 0,
                                                                                             0]]), 'Confidence', 'Recall']]
                  1,
                                1,
                                              1, ...,
                                                                 0,
                                                                               0,
fitness: 0.46885689697962546
keys: ['metrics/precision(B)', 'metrics/recall(B)', 'metrics/mAP50(B)', 'metrics/mAP50-95(B)']
                                             0.54862,
                                                           0.83264,
                                                                        0.12622,
                                                                                        0.193,
                                                                                                    0.30067,
                                                                                                                  0.67494,
                                                                                                                                0.74615, 0.0070519,
maps: array([ 0.50454,
                                0.6263,
                                                                                                                                                            0.43617])
names: {0: 'pickup_truck', 1: 'car', 2: 'articulated_truck', 3: 'bus', 4: 'motorized_vehicle', 5: 'work_van', 6: 'single_unit_truck', 7: 'pedestrian', 8: 'bicycle', 9: 'non_motorized_veh
icle', 10: 'motorcycle'}
plot: True
results_dict: {'metrics/precision(B)': 0.6533993803646944, 'metrics/recall(B)': 0.5337360624740617, 'metrics/mAP50(B)': 0.600702324926506, 'metrics/mAP50-95(B)': 0.45420740498552764, 'fi
tness': 0.46885689697962546}
save_dir: PosixPath('runs/detect/train152')
speed: {'preprocess': 3.9162641979869783, 'inference': 425.8065983421444, 'loss': 6.361946540792989e-05, 'postprocess': 1.4362051079310283}
task: 'detect'
```

val: Scanning /Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/07

val: New cache created: /Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/07 - Capstone/Autonomous Driving/yolov5_vehicle_detection/data/test/labels.cache

Class

Images Instances

Box(P

R mAP50 m

all	290	330	0.76	0.587	0.671	0.502
pickup_truck	59	59	0.805	0.56	0.677	0.576
car	179	195	0.796	0.8	0.812	0.682
articulated_truck	14	14	0.586	0.643	0.676	0.544
bus	18	18	0.944	0.944	0.964	0.867
<pre>motorized_vehicle</pre>	22	22	0.217	0.0455	0.0905	0.0398
work_van	9	9	1	0.425	0.526	0.489
single_unit_truck	4	4	0.852	0.25	0.46	0.379
bicycle	3	3	0.64	1	0.995	0.441
motorcycle	6	6	1	0.618	0.838	0.5

Speed: 2.9ms preprocess, 396.8ms inference, 0.0ms loss, 1.3ms postprocess per image Results saved to runs/detect/train154

ultralytics.utils.metrics.DetMetrics object with attributes: ap_class_index: array([0, 1, 2, 3, 4, 5, 6, 8, 10]) box: ultralytics.utils.metrics.Metric object confusion_matrix: <ultralytics.utils.metrics.ConfusionMatrix object at 0x167afa390> curves: ['Precision-Recall(B)', 'F1-Confidence(B)', 'Precision-Confidence(B)', 'Recall-Confidence(B)'] curves results: [[arrav([0, 0.001001, 0.002002, 0.003003, 0.004004, 0.005005. 0.006006. 0.007007. 0.008008. 0.009009. 0.01001. 0.011011. 012012, 0.013013, 0.014014, 0.015015, 0.016016, 0.017017, 0.018018, 0.019019, 0.02002. 0.021021, 0.022022. 0.023023, 0.024024, 0.025025, 0.026026, 0.027027, 0.028028, 0.029029, 0.03003, 0.031031, 0.032032, 0.033033, 0.034034, 0.035035, 0.036036, 0.03703 0.038038, 0.04004, 0.042042, 0.043043, 0.044044, 0.045045, 0.046046, 0.047047, 0.039039, 0.041041, 0.048048, 0.049049, 0.05005, 0.051051, 0.052052, 0.053053, 0.054054, 0.055055, 0.056056, 0.057057, 0.058058, 0.059059, 0.06006, 0.06106 0.067067, 1, 0.062062, 0.063063, 0.064064, 0.065065, 0.066066, 0.068068, 0.069069, 0.07007, 0.071071, 0.072072, 0.073073, 0.074074, 0.075075, 0.076076, 0.077077, 0.078078, 0.079079, 0.08008, 0.081081, 0.082082, 0.083083, 0.084084, 0.08508 0.095095, 0.086086, 0.087087, 0.088088, 0.089089, 0.09009, 0.091091, 0.092092, 0.093093, 0.094094, 5, 0.097097, 0.1011, 0.096096. 0.098098, 0.099099, 0.1001, 0.1021, 0.1031, 0.1041, 0.10511. 0.10611. 0.10711, 0.10811, 0.1091 1, 0.11011. 0.11111. 0.11211. 0.11311. 0.11411. 0.11512. 0.11612, 0.11712. 0.11812. 0.11912. 0.12012, 0.12112, 0.12212, 0.12312, 0.12412, 0.12513, 0.12613, 0.12713, 0.12813, 0.12913. 0.13013, 0.13113, 0.13213, 0.1331 0.13413, 0.13714, 0.13814, 0.13914, 0.14014, 0.14114, 0.14214, 0.14314, 0.13514, 0.13614, 3, 0.14414, 0.14515, 0.14615, 0.14915, 0.15015, 0.14715, 0.14815, 0.15115, 0.15215, 0.15315. 0.15415, 0.1571 0.15516, 0.15616, 0.15816, 0.15916, 0.16016, 0.16116, 0.16216, 0.16316, 0.16416, 0.16517, 0.16617, 0.16717, 6, 0.16817, 0.16917, 0.17017, 0.17117, 0.17217, 0.17317, 0.17417, 0.17518, 0.17618, 0.17718, 0.17818, 0.17918, 0.18018, 0.1811 0.18318, 0.18418, 0.18519, 0.18719, 0.18819, 0.18919, 0.19019, 0.19119, 8, 0.18218, 0.18619, 0.19219, 0.19319, 0.19419, 0.1952, 0.1962, 0.1972, 0.1982, 0.1992, 0.2002, 0.2012, 0.2022, 0.2032, 0.2042, 0.2052 0.21221, 1, 0.20621, 0.20721, 0.20821, 0.20921, 0.21021, 0.21121, 0.21321, 0.21421, 0.21522, 0.21622, 0.21722, 0.21822, 0.21922, 0.22022, 0.22122, 0.22222, 0.22322, 0.22422, 0.22523. 0.22623, 0.22723, 0.22823, 0.2292 0.23023, 0.23223, 0.23323, 0.23423, 0.23524, 0.23624, 0.23724, 0.23824, 3, 0.23123, 0.23924, 0.24024, 0.24124, 0.24224, 0.24324, 0.24424, 0.24525, 0.24625, 0.24725. 0.24825, 0.24925, 0.25025, 0.25125, 0.25225, 0.2532 0.25425, 0.25526, 0.25626, 0.25726, 0.25826, 0.25926, 0.26026, 0.26126, 0.26226, 0.26326, 5, 0.2772 0.26426, 0.26527, 0.26627, 0.26727, 0.26827, 0.26927, 0.27027, 0.27127, 0.27227, 0.27327, 0.27427, 0.27528, 0.27628, 0.27928, 0.28028, 0.28128, 0.28228, 0.28328, 0.28428, 0.28529, 0.28629, 0.28729, 8, 0.27828, 0.28829, 0.28929, 0.29029, 0.29129, 0.29229, 0.29329, 0.29429, 0.2953, 0.2963, 0.2973, 0.2983, 0.2993, 0.3003, 0.301 3, 0.3023, 0.3033, 0.3043, 0.30531, 0.30631, 0.30731, 0.30831, 0.30931, 0.31031, 0.31131, 0.31532, 0.31732, 0.31932, 0.32032, 0.32132, 0.32232, 0.3253 0.31231, 0.31331, 0.31431, 0.31632, 0.31832, 0.32332, 0.32432, 0.33033, 0.33333, 0.32733, 0.32833, 0.32933, 0.33133, 0.33233, 0.33433, 0.33534, 3, 0.32633, 0.34234, 0.34334, 0.34434, 0.33834, 0.33934, 0.34034, 0.34134, 0.34535, 0.34635, 0.34735, 0.3493 0.33634, 0.33734, 0.34835, 5, 0.35035, 0.35135, 0.35235, 0.35335, 0.35435, 0.35536, 0.35636, 0.35736, 0.35836, 0.35936, 0.36136, 0.36436, 0.36637, 0.36036, 0.36236, 0.36336, 0.36537, 0.36737, 0.36837, 0.36937, 0.37037, 0.37137, 0.37237, 0.3733 7, 0.37437, 0.37538, 0.37638, 0.37738, 0.37838, 0.37938, 0.38038, 0.38138, 0.38238, 0.38338, 0.38438, 0.38639, 0.38739, 0.38839, 0.38939, 0.39039, 0.39139, 0.39239, 0.39339, 0.39439, 0.3954, 0.3964, 0.397 0.38539, 4, 0.3984, 0.3994, 0.4004, 0.4014, 0.4024, 0.4034, 0.4044, 0.40541, 0.40641, 0.40741, 0.40841, 0.41642, 0.41842, 0.42042, 0.4214 0.40941, 0.41041, 0.41141, 0.41241, 0.41341, 0.41441, 0.41542, 0.41742, 0.41942, 0.42543, 0.42743, 0.43043, 2, 0.42242, 0.42342, 0.42442, 0.42643, 0.42843, 0.42943, 0.43143, 0.43644, 0.43243, 0.43343, 0.43443, 0.43544, 0.43744, 0.43844, 0.43944, 0.44044, 0.44244, 0.4454 0.44144, 0.44344, 0.44444, 0.44645, 0.44745, 0.44845, 0.44945, 0.45045, 0.45145, 0.45245, 0.45345, 0.45445, 0.45546, 5, 0.45646, 0.45746, 0.45846, 0.45946, 0.46046, 0.46146, 0.46246, 0.46346, 0.46446, 0.46547, 0.46647, 0.46747, 0.46847, 0.4694 0.47848, 0.47047, 0.47147, 0.47247, 0.47347, 0.47447, 0.47548, 0.47648, 0.47748, 0.47948, 7, 0.48048, 0.48148, 0.48248, 0.48348, 0.48448, 0.48549, 0.48649, 0.48749, 0.48849, 0.48949, 0.49049, 0.49149, 0.49249, 0.4934 9, 0.49449, 0.4955, 0.4965, 0.4975, 0.4985, 0.4995, 0.5005, 0.5015, 0.5025, 0.5035, 0.50751, 0.50951, 0.51251, 0.51351, 0.51451, 0.51652, 0.5175 0.5045, 0.50551, 0.50651, 0.50851, 0.51051, 0.51151, 0.51552, 2, 0.51952, 0.52052, 0.52152, 0.52252, 0.52352, 0.52452, 0.52553, 0.52653, 0.52753, 0.51852, 0.53153, 0.53353, 0.53554, 0.53654, 0.53854, 0.54054, 0.52853, 0.52953, 0.53053, 0.53253, 0.53453, 0.53754, 0.53954, 0.5415 0.54254, 0.54354, 0.54454, 0.54555, 0.54655, 0.54755, 0.54855, 0.54955, 0.55055, 0.55155, 4, 0.55355, 0.55656, 0.55455, 0.55556, 0.55756, 0.55856, 0.55956, 0.56056, 0.56156, 0.56256, 0.56356, 0.56456, 0.5655 0.55255, 0.57558, 7, 0.56657, 0.56757, 0.56857, 0.56957, 0.57057, 0.57157, 0.57257, 0.57357, 0.57457,

```
0.57958,
                                                                    0.58258,
                  0.57758,
                            0.57858,
                                                0.58058, 0.58158,
                                                                              0.58358,
                                                                                                   0.58559.
                                                                                                             0.58659,
                                                                                                                       0.58759,
                                                                                                                                 0.58859,
                                                                                                                                           0.5895
                                                                                        0.58458,
     0.59059, 0.59159, 0.59259, 0.59359, 0.59459, 0.5956, 0.5966, 0.5976, 0.5986, 0.5996,
9,
         0.6006, 0.6016, 0.6026, 0.6036, 0.6046, 0.60561, 0.60661, 0.60761, 0.60861, 0.60961,
                                                                                                                                           0.6136
                                                                                                             0.61061,
                                                                                                                       0.61161,
                                                                                                                                 0.61261,
     0.61461, 0.61562, 0.61662, 0.61762, 0.61862, 0.61962, 0.62062, 0.62162, 0.62262, 0.62362,
        0.62462, 0.62563, 0.62663, 0.62763, 0.62863, 0.62963, 0.63063, 0.63163, 0.63263, 0.63363,
                                                                                                                                           0.6376
                                                                                                             0.63463.
                                                                                                                       0.63564,
                                                                                                                                 0.63664,
     0.63864,
              0.63964, 0.64064, 0.64164, 0.64264, 0.64364, 0.64464, 0.64565, 0.64665, 0.64765,
                  0.64965, 0.65065, 0.65165, 0.65265, 0.65365, 0.65465, 0.65566,
                                                                                        0.65666, 0.65766,
                                                                                                             0.65866,
                                                                                                                       0.65966,
                                                                                                                                 0.66066,
                                                                                                                                           0.6616
                         0.66466, 0.66567, 0.66667, 0.66767, 0.66867, 0.66967, 0.67067, 0.67167,
6,
     0.66266,
               0.66366,
        0.67267, 0.67367, 0.67467, 0.67568, 0.67668, 0.67768, 0.67868, 0.67968, 0.68068,
                                                                                                0.68168.
                                                                                                             0.68268,
                                                                                                                       0.68368,
                                                                                                                                 0.68468,
                                                                                                                                           0.6856
               0.68769, 0.68869, 0.68969, 0.69069, 0.69169, 0.69269, 0.69369, 0.69469,
     0.68669,
                                                                                                0.6957.
         0.6967, 0.6977, 0.6987, 0.6997, 0.7007, 0.7017, 0.7027, 0.7037, 0.7047,
                                                                                                  0.70571.
                                                                                                             0.70671.
                                                                                                                       0.70771,
                                                                                                                                 0.70871,
                                                                                                                                           0.7097
               0.71171, 0.71271, 0.71371, 0.71471, 0.71572, 0.71672, 0.71772, 0.71872, 0.71972,
     0.71071,
1,
                  0.72172, 0.72272, 0.72372, 0.72472, 0.72573, 0.72673, 0.72773, 0.72873,
                                                                                                             0.73073,
                                                                                                                                           0.7337
                                                                                                                       0.73173,
                                                                                                                                 0.73273,
              0.73574, 0.73674, 0.73774, 0.73874, 0.73974, 0.74074, 0.74174, 0.74274, 0.74374,
3,
        0.74474, 0.74575, 0.74675, 0.74775, 0.74875, 0.74975, 0.75075, 0.75175, 0.75275, 0.75375,
                                                                                                             0.75475,
                                                                                                                       0.75576,
                                                                                                                                 0.75676,
                                                                                                                                           0.7577
             0.75976, 0.76076, 0.76176, 0.76276, 0.76376, 0.76476, 0.76577, 0.76677, 0.76777,
6,
     0.75876,
        0.76877, 0.76977, 0.77077, 0.77177, 0.77277, 0.77377, 0.77477, 0.77578, 0.77678, 0.77778,
                                                                                                             0.77878,
                                                                                                                       0.77978,
                                                                                                                                 0.78078,
                                                                                                                                           0.7817
              0.78378, 0.78478, 0.78579, 0.78679, 0.78779, 0.78879, 0.78979, 0.79079, 0.79179,
        0.79279, 0.79379, 0.79479, 0.7958, 0.7968, 0.7978, 0.7988, 0.7998, 0.8008, 0.8018,
                                                                                                                       0.8038,
                                                                                                                                 0.8048.
                                                                                                                                           0.8058
                                                                                                             0.8028.
                         0.80881, 0.80981, 0.81081, 0.81181, 0.81281, 0.81381, 0.81481, 0.81582,
              0.80781,
1,
        0.81682, 0.81782, 0.81882, 0.81982, 0.82082, 0.82182, 0.82282, 0.82382, 0.82482, 0.82583,
                                                                                                                                 0.82883,
                                                                                                                                           0.8298
                                                                                                             0.82683,
                                                                                                                       0.82783,
              0.83183, 0.83283, 0.83383, 0.83483, 0.83584, 0.83684, 0.83784, 0.83884, 0.83984,
3,
     0.83083,
        0.84084, 0.84184, 0.84284, 0.84384, 0.84484, 0.84585, 0.84685, 0.84785, 0.84885, 0.84985,
                                                                                                             0.85085,
                                                                                                                       0.85185,
                                                                                                                                 0.85285,
                                                                                                                                           0.8538
              0.85586, 0.85686, 0.85786, 0.85886, 0.85986, 0.86086, 0.86186, 0.86286, 0.86386,
5,
        0.86486, 0.86587, 0.86687, 0.86787, 0.86887, 0.86987, 0.87087, 0.87187, 0.87287,
                                                                                                             0.87487,
                                                                                                                       0.87588,
                                                                                                                                 0.87688,
                                                                                                                                           0.8778
             0.87988, 0.88088, 0.88188, 0.88288, 0.88388, 0.88488, 0.88589, 0.88689, 0.88789,
8,
        0.88889, 0.88989, 0.89089, 0.89189, 0.89289, 0.89389, 0.89489, 0.8959, 0.8969, 0.8979,
                                                                                                             0.8989,
                                                                                                                       0.8999,
                                                                                                                                 0.9009,
                                                                                                                                           0.901
9,
      0.9029.
                0.9039, 0.9049, 0.90591, 0.90691, 0.90791, 0.90891, 0.90991, 0.91091, 0.91191,
        0.91291,
                 0.91391, 0.91491, 0.91592, 0.91692, 0.91792, 0.91892, 0.91992, 0.92092, 0.92192,
                                                                                                             0.92292.
                                                                                                                       0.92392,
                                                                                                                                 0.92492,
                                                                                                                                           0.9259
               0.92793, 0.92893, 0.92993, 0.93093, 0.93193, 0.93293, 0.93393, 0.93493, 0.93594,
3,
                  0.93794, 0.93894, 0.93994, 0.94094, 0.94194, 0.94294, 0.94394, 0.94494,
                                                                                                                                           0.9499
        0.93694,
                                                                                                             0.94695,
                                                                                                                       0.94795,
                                                                                                                                 0.94895,
     0.95095,
               0.95195, 0.95295, 0.95395, 0.95495, 0.95596, 0.95696, 0.95796, 0.95896, 0.95996,
5,
        0.96096,
                  0.96196, 0.96296, 0.96396, 0.96496, 0.96597, 0.96697, 0.96797, 0.96897, 0.96997,
                                                                                                             0.97097,
                                                                                                                       0.97197,
                                                                                                                                 0.97297,
                                                                                                                                           0.9739
                                   0.97798, 0.97898, 0.97998,
                                                              0.98098, 0.98198, 0.98298, 0.98398,
     0.97497,
              0.97598, 0.97698,
7,
        0.98498,
                  0.98599, 0.98699,
                                   0.98799, 0.98899, 0.98999, 0.99099,
                                                                              0.99199, 0.99299,
                                                                                                  0.99399.
                                                                                                             0.99499.
                                                                                                                        0.996,
                                                                                                                                  0.997,
                                                                                                                                            0.99
                                                         1, ..., 0.0014686, 0.00073428, 0],
       0.999,
                   1]), array([[
                                               1,
                                     1,
                                         0.0025172, 0.0012586,
                                                                    0],
                       1,
                                 1, ...,
                                         0.0007075, 0.00035375,
             1,
                       1,
                                 1, ...,
                                 1, ..., 6.5106e-05, 3.2553e-05,
                                                                   0],
              1,
                       1,
                                 1, ..., 1, 1,
                       1,
                                                                   0],
                                 1, ..., 0.00048829, 0.00024415, 0]]), 'Recall', 'Precision'], [array([ 0, 0.001001,
                                                                                                                       0.002002,
                                                                                                                                 0.003003,
      0.005005, 0.006006, 0.007007, 0.008008, 0.009009, 0.01001, 0.011011, 0.012012, 0.013013, 0.014014, 0.015015,
                                                                                                                    0.016016,
                                                                                                                              0.017017,
                                                                                                                                        0.018018,
0.019019, 0.02002, 0.021021, 0.022022, 0.023023,
       0.024024, 0.025025, 0.026026, 0.027027, 0.028028, 0.029029, 0.03003, 0.031031, 0.032032, 0.033033,
                                                                                                            0.034034,
                                                                                                                      0.035035,
                                                                                                                                0.036036,
                                                                                                                                          0.03703
    0.038038, 0.039039,
                      0.04004, 0.041041, 0.042042, 0.043043, 0.044044, 0.045045, 0.046046, 0.047047,
       0.048048, 0.049049, 0.05005, 0.051051, 0.052052, 0.053053, 0.054054, 0.055055, 0.056056, 0.057057,
                                                                                                            0.058058,
                                                                                                                      0.059059,
                                                                                                                                 0.06006,
                                                                                                                                          0.06106
    0.062062, 0.063063, 0.064064, 0.065065, 0.066066, 0.067067, 0.068068, 0.069069, 0.07007, 0.071071,
1,
       0.072072, 0.073073, 0.074074, 0.075075, 0.076076, 0.077077, 0.078078, 0.079079, 0.08008, 0.081081,
                                                                                                            0.082082,
                                                                                                                      0.083083,
                                                                                                                                0.084084,
                                                                                                                                          0.08508
    0.086086, 0.087087, 0.088088, 0.089089, 0.09009, 0.091091, 0.092092, 0.093093, 0.094094, 0.095095,
       0.096096, 0.097097, 0.098098, 0.099099, 0.1001, 0.1011, 0.1021, 0.1031, 0.1041, 0.10511,
                                                                                                             0.10611,
                                                                                                                       0.10711,
                                                                                                                                 0.10811,
                                                                                                                                           0.1091
     0.11011,
              0.1111, 0.1121, 0.11311, 0.11411, 0.11512, 0.11612, 0.11712, 0.11812, 0.11912,
1,
                 0.12112, 0.12212, 0.12312, 0.12412, 0.12513, 0.12613, 0.12713,
                                                                                        0.12813, 0.12913,
        0.12012,
                                                                                                             0.13013,
                                                                                                                                           0.1331
                                                                                                                       0.13113,
                                                                                                                                 0.13213,
               0.13514,
                         0.13614,
                                   0.13714, 0.13814, 0.13914, 0.14014, 0.14114,
                                                                                     0.14214,
3,
        0.14414,
                  0.14515, 0.14615, 0.14715, 0.14815, 0.14915, 0.15015,
                                                                              0.15115,
                                                                                        0.15215,
                                                                                                  0.15315,
                                                                                                             0.15415,
                                                                                                                       0.15516,
                                                                                                                                 0.15616,
                                                                                                                                           0.1571
               0.15916,
                      0.16016,
                                   0.16116, 0.16216, 0.16316, 0.16416, 0.16517, 0.16617, 0.16717,
     0.15816,
                  0.16917, 0.17017, 0.17117, 0.17217, 0.17317, 0.17417, 0.17518, 0.17618,
                                                                                                  0.17718,
                                                                                                             0.17818,
                                                                                                                       0.17918,
                                                                                                                                 0.18018,
                                                                                                                                           0.1811
        0.16817,
                                0.18519, 0.18619, 0.18719, 0.18819, 0.18919,
     0.18218,
               0.18318,
                      0.18418,
                                                                                   0.19019, 0.19119,
8,
                  0.19319, 0.19419, 0.1952, 0.1962, 0.1972, 0.1982, 0.1992, 0.2002,
                                                                                                                                           0.2052
                                                                                                             0.2022,
                                                                                                                       0.2032,
                                                                                                                                 0.2042,
              0.20721,
                      0.20821, 0.20921, 0.21021, 0.21121, 0.21221, 0.21321, 0.21421, 0.21522,
1,
        0.21622, 0.21722, 0.21822, 0.21922, 0.22022, 0.22122, 0.22222, 0.22322, 0.22422, 0.22523,
                                                                                                                                           0.2292
                                                                                                             0.22623,
                                                                                                                       0.22723,
                                                                                                                                 0.22823,
              0.23123,
                       0.23223, 0.23323, 0.23423, 0.23524, 0.23624, 0.23724, 0.23824, 0.23924,
     0.23023,
                 0.24124, 0.24224, 0.24324, 0.24424, 0.24525, 0.24625, 0.24725, 0.24825, 0.24925,
        0.24024,
                                                                                                             0.25025,
                                                                                                                       0.25125,
                                                                                                                                 0.25225,
                                                                                                                                           0.2532
               0.25526,
                         0.25626,
                                   0.25726,
                                             0.25826, 0.25926,
                                                              0.26026, 0.26126,
                                                                                     0.26226, 0.26326,
                                                                                                0.27327,
                  0.26527,
                         0.26627,
                                     0.26727, 0.26827, 0.26927, 0.27027, 0.27127,
                                                                                        0.27227,
                                                                                                             0.27427,
                                                                                                                       0.27528,
                                                                                                                                 0.27628,
                                                                                                                                           0.2772
        0.26426,
8,
     0.27828,
               0.27928,
                         0.28028,
                                   0.28128,
                                             0.28228,
                                                       0.28328,
                                                                 0.28428,
                                                                           0.28529,
                                                                                     0.28629,
```

2	0.28829,	•		0.29129,		0.29329,				0.2973, 0.31131,	0.2983,	0.2993,	0.3003,	0.301
3,	0.3023, 0.31231,	0.3033, 0.31331,		0.30531, 0.31532,		0.30731, 0.31732,	0.30831, 0.31832,	0.30931, 0.31932,	0.31031, 0.32032,	•	0.32232,	0.32332,	0.32432,	0.3253
3,	0.32633,	0.32733,	0.32833,	0.32933,	0.33033,	0.33133,	0.33233,	0.33333,	0.33433,	0.33534,	-	•	•	
5,	0.33634, 0.35035,	0.33734, 0.35135,	0.33834, 0.35235,	0.33934, 0.35335,	0.34034, 0.35435,	0.34134, 0.35536,	0.34234, 0.35636,	0.34334, 0.35736,	0.34434, 0.35836,	0.34535, 0.35936,	0.34635,	0.34735,	0.34835,	0.3493
3,	0.36036,	0.36136,							-	•	0.37037,	0.37137,	0.37237,	0.3733
7,	0.37437, 0.38438,	0.37538, 0.38539,		0.37738, 0.38739,	0.37838, 0.38839,	0.37938, 0.38939,	0.38038, 0.39039,	0.38138, 0.39139,	0.38238, 0.39239,	0.38338, 0.39339,	0.39439,	0.3954,	0.3964,	0.397
4,	0.3984,	0.3994,	0.38039,	0.4014,	0.4024,	0.4034,	0.4044,	0.40541,	0.40641,	0.40741,	0.39439,	0.3934,	0.3904,	0.397
2	0.40841,	0.40941,	•							-	0.41842,	0.41942,	0.42042,	0.4214
2,	0.42242, 0.43243,	0.42342, 0.43343,	0.42442, 0.43443,	0.42543, 0.43544,	0.42643, 0.43644,	0.42743, 0.43744,	0.42843, 0.43844,	0.42943, 0.43944,	0.43043, 0.44044,	0.43143, 0.44144,	0.44244,	0.44344,	0.44444,	0.4454
5,	0.44645,	0.44745,	0.44845,	0.44945,	0.45045,	0.45145,	0.45245,	0.45345,	0.45445,	0.45546,		•	•	
7.	0.45646, 0.47047,		0.45846, 0.47247,	0.45946, 0.47347,	0.46046, 0.47447,	0.46146, 0.47548,	0.46246, 0.47648,	0.46346, 0.47748,	0.46446, 0.47848,	0.46547, 0.47948,	0.46647,	0.46747,	0.46847,	0.4694
,,	0.48048,	0.48148,	0.48248,	0.48348,	0.48448,	0.48549,	0.48649,	0.48749,	0.48849,	0.48949,	0.49049,	0.49149,	0.49249,	0.4934
9,	0.49449, 0.5045,	0.4955, 0.50551,	0.4965, 0.50651,	0.4975, 0.50751,	0.4985, 0.50851,	0.4995, 0.50951,	0.5005, 0.51051,	0.5015, 0.51151,	0.5025, 0.51251,	0.5035, 0.51351,	0.51451,	0.51552,	0.51652,	0.5175
2,	-		0.52052,	0.52152,	0.52252,	0.52352,	0.52452,	0.52553,	0.52653,	0.52753,	0.31431,	0.31332,	0.31032,	0.31/3
4	0.52853,		•					0.53554, 0.54955,		•	0.53854,	0.53954,	0.54054,	0.5415
4,	0.54254, 0.55255,	0.54354, 0.55355,	0.54454, 0.55455,	0.54555, 0.55556,	0.54655, 0.55656,	0.54755, 0.55756,	0.54855, 0.55856,	•	0.55055, 0.56056,	0.55155, 0.56156,	0.56256,	0.56356,	0.56456,	0.5655
7,	0.56657,	0.56757,	0.56857,	0.56957,	0.57057,	0.57157,	0.57257,	0.57357,	0.57457,	0.57558,	-		•	0 5005
9,	0.57658, 0.59059,	0.57758, 0.59159,	0.57858, 0.59259,	0.57958, 0.59359,	0.58058, 0.59459,	0.58158, 0.5956,	0.58258, 0.5966,	0.58358, 0.5976,	0.58458, 0.5986,	0.58559, 0.5996,	0.58659,	0.58759,	0.58859,	0.5895
- /	0.6006,	0.6016,	0.6026,	0.6036,	0.6046,	0.60561,	0.60661,	0.60761,	0.60861,	0.60961,	0.61061,	0.61161,	0.61261,	0.6136
1,	0.61461, 0.62462,	0.61562, 0.62563,		0.61762, 0.62763,	0.61862, 0.62863,		0.62062, 0.63063,	0.62162, 0.63163,	0.62262, 0.63263,	0.62362, 0.63363,	0.63463,	0.63564,	0.63664,	0.6376
4,				0.64164,	0.64264,		0.64464,	0.64565,	0.64665,	0.64765,		0103304,	0103004,	010370
6	0.64865,	0.64965, 0.66366,	•				0.65465, 0.66867,	0.65566, 0.66967,	0.65666, 0.67067,	0.65766, 0.67167,	0.65866,	0.65966,	0.66066,	0.6616
6,	0.66266, 0.67267,			0.66567, 0.67568,		0.66767, 0.67768,					0.68268,	0.68368,	0.68468,	0.6856
9,				0.68969,	0.69069,	0.69169,	0.69269,	0.69369,	0.69469,	0.6957,	0 70671	0 70771	0 70071	0 7007
1,	0.6967, 0.71071,	0.6977, 0.71171,	0.6987, 0.71271,	0.6997, 0.71371,	0.7007, 0.71471,	0.7017, 0.71572,	0.7027, 0.71672,	0.7037, 0.71772,	0.7047, 0.71872,	0.70571, 0.71972,	0.70671,	0.70771,	0.70871,	0.7097
	0.72072,	0.72172,	0.72272,	0.72372,	0.72472,	0.72573,	0.72673,	0.72773,	0.72873,	0.72973,	0.73073,	0.73173,	0.73273,	0.7337
3,	0.73473, 0.74474,	0.73574, 0.74575,			0.73874, 0.74875.	0.73974, 0.74975,			•	0.74374, 0.75375,	0.75475,	0.75576,	0.75676,	0.7577
6,	0.75876,	0.75976,	0.76076,	0.76176,	0.76276,	0.76376,	0.76476,	0.76577,	0.76677,	0.76777,	·	•	•	
8,	0.76877, 0.78278,			0.77177, 0.78579,		0.77377, 0.78779,	0.77477, 0.78879,	0.77578, 0.78979,	0.77678, 0.79079,	0.77778, 0.79179,	0.77878,	0.77978,	0.78078,	0.7817
٥,	0.79279,	0.79379,	0.79479,		0.7968,	0.7978,	0.7988,		0.8008,	0.8018,	0.8028,	0.8038,	0.8048,	0.8058
1,	0.80681, 0.81682,			0.80981, 0.81982,			0.81281, 0.82282,	0.81381, 0.82382,	0.81481, 0.82482,	0.81582, 0.82583,	0.82683,	0.82783,	0.82883,	0.8298
3,				0.83383,			0.83684,	0.83784,	0.83884,	0.83984,	0.02003,	0.02703,	0.02003,	0.0290
F	0.84084,	•									0.85085,	0.85185,	0.85285,	0.8538
5,	0.85485, 0.86486,	0.85586, 0.86587,	•	0.85786, 0.86787,	0.85886, 0.86887,	0.85986, 0.86987,	0.86086, 0.87087,		0.86286, 0.87287,	0.86386, 0.87387,	0.87487,	0.87588,	0.87688,	0.8778
8,	-	-	0.88088,	0.88188,	0.88288,	0.88388,	0.88488,	0.88589,	0.88689,	0.88789,				0.004
9,	0.88889, 0.9029,	0.88989, 0.9039,		0.89189, 0.90591,	0.89289, 0.90691,		0.89489, 0.90891,	0.8959, 0.90991,	0.8969, 0.91091,	0.8979, 0.91191,	0.8989,	0.8999,	0.9009,	0.901
	0.91291,	0.91391,	0.91491,	0.91592,	0.91692,	0.91792,	0.91892,	0.91992,	0.92092,	0.92192,	0.92292,	0.92392,	0.92492,	0.9259
3,	0.92693, 0.93694,			0.92993, 0.93994,		0.93193, 0.94194,	0.93293, 0.94294,		0.93493, 0.94494,	0.93594, 0.94595,	0.94695,	0.94795,	0.94895,	0.9499
5,	0.95095,	0.95195,	0.95295,	0.95395,	0.95495,	0.95596,	0.95696,	0.95796,	0.95896,	0.95996,			•	
7,	0.96096, 0.97497,	0.96196, 0.97598,		0.96396, 0.97798,	0.96496, 0.97898,					0.96997, 0.98398,	0.97097,	0.97197,	0.97297,	0.9739
· ,	0.98498,	0.98599,	0.98699,	0.98799,	0.98899,	0.98999,	0.99099,	0.99199,	0.99299,	0.99399,	0.99499,	0.996,	0.997,	0.99
8,	0.999, [0.02546,		rray([[0.02 , 0.029836		0.0 0,	27081,, 0,	0, 0],	0,	0],					
	[0.049149,				0,	0,	0],							
	,	0 016006	a a27212		0	ρ	0 1							
	[0.016086, [0.019868,	0.019868	, 0.031969		0, 0,	0, 0,	0], 0],							
	[0.077519,	0.077519	, 0.14485	,,	0,	0,	0]]), 'Co	nfidence', 'F	1'], [array([0,	0.001001,	0.002002,	0.003003,	0.00400

-		0.006006, 002, 0.0210				0.01001,	0.011011,	0.012012,	0.013013,	0.014014,	0.015015,	0.016016,	0.017017,	0.018018,
0101	0.024024	0.025025,	0.026026,	0.027027,	0.028028,					, 0.033033,	0.034034,	0.035035,	0.036036,	0.03703
7,	0.038038, 0.048048	0.039039, 0.049049,			0.042042, 0.052052,				0.046046, 0.056056,		0.058058,	0.059059,	0.06006,	0.06106
1,	0.062062,	0.063063,	0.064064,	0.065065,	0.066066,	0.067067,	0.068068,	0.069069,	0.07007,	0.071071,		•		
5,	0.072072 0.086086,			0.075075, 0.089089,	0.076076, 0.09009.		0.078078, 0.092092,			, 0.081081, 0.095095,	0.082082,	0.083083,	0.084084,	0.08508
٥,	0.096096	0.097097,	0.098098,	0.099099,	0.1001,	0.1011,	0.1021,	0.1031,	0.1041	0.10511,	0.10611,	0.10711,	0.10811,	0.1091
1,	0.11011, 0.12012	0.11111, , 0.12112,	0.11211, 0.12212,	0.11311, 0.12312,		0.11512, 0.12513,	0.11612, 0.12613,	0.11712, 0.12713,	0.11812, 0.12813,	0.11912, , 0.12913,	0.13013,	0.13113,	0.13213,	0.1331
3,	0.13413,	0.13514,	0.13614,	0.13714,	0.13814,	0.13914,	0.14014,	0.14114,	0.14214,	0.14314,		•	•	
6,	0.14414, 0.15816,	, 0.14515, 0.15916,	0.14615, 0.16016,	0.14715, 0.16116,	0.14815, 0.16216,	0.14915, 0.16316,	0.15015, 0.16416,	0.15115, 0.16517,	0.15215, 0.16617,	, 0.15315, 0.16717,	0.15415,	0.15516,	0.15616,	0.1571
٠,	0.16817	0.16917,	0.17017,	0.17117,	0.17217,	0.17317,	0.17417,	0.17518,	0.17618	0.17718,	0.17818,	0.17918,	0.18018,	0.1811
8,	0.18218, 0.19219	0.18318, , 0.19319,	0.18418, 0.19419,	0.18519, 0.1952,	0.18619, 0.1962,	0.18719, 0.1972,	0.18819, 0.1982,	0.18919, 0.1992,	0.19019, 0.2002,	0.19119, , 0.2012,	0.2022,	0.2032,	0.2042,	0.2052
1,	0.20621,	0.20721,	0.20821,	0.20921,	0.21021,	0.21121,	0.21221,	0.21321,	0.21421,	0.21522,		•	•	
3,	0.21622, 0.23023,	, 0.21722, 0.23123,	0.21822, 0.23223,	0.21922, 0.23323,	0.22022, 0.23423,	0.22122, 0.23524,	0.22222, 0.23624,	0.22322, 0.23724,	0.22422, 0.23824,	, 0.22523, 0.23924,	0.22623,	0.22723,	0.22823,	0.2292
	0.24024	0.24124,	0.24224,	0.24324,	0.24424,	0.24525,	0.24625,	0.24725,	0.24825	0.24925,	0.25025,	0.25125,	0.25225,	0.2532
5,	0.25425, 0.26426	0.25526, , 0.26527,	0.25626, 0.26627,	0.25726, 0.26727,	0.25826, 0.26827,	0.25926, 0.26927,	0.26026, 0.27027,	0.26126, 0.27127,	0.26226, 0.27227,	0.26326, , 0.27327,	0.27427,	0.27528,	0.27628,	0.2772
8,	0.27828,	0.27928,	0.28028,	0.28128,	0.28228,	0.28328,	0.28428,	0.28529,	0.28629,	0.28729,		•	•	
3,	0.28829 0.3023,	, 0.28929, 0.3033,	0.29029, 0.3043,	0.29129, 0.30531,	0.29229, 0.30631,	0.29329, 0.30731,	0.29429, 0.30831,	0.2953, 0.30931,	0.2963, 0.31031,	, 0.2973, 0.31131,	0.2983,	0.2993,	0.3003,	0.301
٥,	0.31231	-		_					0.32032	0.32132,	0.32232,	0.32332,	0.32432,	0.3253
3,	0.32633, 0.33634	0.32733, 0.33734,	0.32833, 0.33834,	0.32933, 0.33934,	0.33033, 0.34034,	0.33133, 0.34134,	0.33233, 0.34234,	0.33333, 0.34334,	0.33433, 0.34434,	0.33534, , 0.34535,	0.34635,	0.34735,	0.34835,	0.3493
5,	0.35035,	0.35135,	0.35235,	0.35335,	0.35435,	0.35536,	0.35636,	0.35736,	0.35836,	0.35936,	0.54055	0.54755,	0.54055,	0:5495
7,	0.36036, 0.37437,	0.36136, 0.37538,	0.36236, 0.37638,	0.36336, 0.37738,	0.36436, 0.37838,	0.36537, 0.37938,	0.36637, 0.38038,	0.36737, 0.38138,	0.36837, 0.38238,	, 0.36937, 0.38338,	0.37037,	0.37137,	0.37237,	0.3733
,,	0.38438	•	0.38639,		0.38839,	0.38939,					0.39439,	0.3954,	0.3964,	0.397
4,	0.3984, 0.40841	0.3994, 0.40941,	0.4004, 0.41041,	0.4014, 0.41141,	0.4024,	0.4034, 0.41341,	0.4044,	0.40541, 0.41542,	0.40641, 0.41642,	0.40741, , 0.41742,	0.41842,	0.41942,	0.42042,	0.4214
2,	0.42242,	0.42342,	0.42442,	0.42543,	0.42643,	0.42743,	0.42843,	0.42943,	0.43043,	0.43143,		0.41942,	0.42042,	0.4214
5,	0.43243, 0.44645,	, 0.43343, 0.44745,	0.43443, 0.44845,	0.43544, 0.44945,		0.43744, 0.45145,	0.43844, 0.45245,	0.43944, 0.45345,	0.44044, 0.45445,	, 0.44144, 0.45546,	0.44244,	0.44344,	0.44444,	0.4454
٥,	0.45646	•			0.46046,		_		•	•	0.46647,	0.46747,	0.46847,	0.4694
7,	0.47047, 0.48048	0.47147,	0.47247, 0.48248,	0.47347, 0.48348,		0.47548,	0.47648, 0.48649,	0.47748,	0.47848, 0.48849	0.47948, 0.48949,	0.49049,	0.49149,	0.49249,	0.4934
9,	0.49449,	, 0.48148, 0.4955,	0.4965,	0.4975,	0.4985,	0.4995,	0.5005,	0.5015,	0.5025,	0.5035,	0.49049,	0.49149,	0.49249,	0.4934
2	0.5045	•		0.50751, 0.52152,	•	0.50951, 0.52352,			0.51251, 0.52653,		0.51451,	0.51552,	0.51652,	0.5175
2,	0.51852, 0.52853	0.51952, , 0.52953,	0.52052, 0.53053,	•	•	•	0.52452, 0.53453,	0.52553, 0.53554,	•	0.52753, , 0.53754,	0.53854,	0.53954,	0.54054,	0.5415
4,	0.54254,	0.54354,	0.54454,	0.54555,		0.54755,	0.54855,	0.54955,	0.55055,	0.55155,	0 56356	0 56256	0 56456	0 5655
7,	0.55255, 0.56657,	, 0.55355, 0.56757,	0.55455, 0.56857,	0.55556, 0.56957,		0.55756, 0.57157,	0.55856, 0.57257,	0.55956, 0.57357,	0.56056, 0.57457,	, 0.56156, 0.57558,	0.56256,	0.56356,	0.56456,	0.5655
0	0.57658 0.59059,	•	•							, 0.58559, 0.5996,	0.58659,	0.58759,	0.58859,	0.5895
9,	0.59059, 0.6006	0.59159, , 0.6016,	0.59259, 0.6026,	0.59359, 0.6036,	0.59459, 0.6046,	0.5956, 0.60561,	0.5966, 0.60661,	0.5976, 0.60761,	0.5986, 0.60861,	•	0.61061,	0.61161,	0.61261,	0.6136
1,	0.61461,	0.61562,	0.61662,	0.61762,		0.61962,	0.62062,	0.62162,	0.62262,	0.62362,	0 62462	0 62564	0.63664	0 6276
4,	0.62462, 0.63864,	, 0.62563, 0.63964,	0.62663, 0.64064,	0.62763, 0.64164,	0.62863, 0.64264,	0.62963, 0.64364,	0.63063, 0.64464,	0.63163, 0.64565,	0.63263; 0.64665,	, 0.63363, 0.64765,	0.63463,	0.63564,	0.63664,	0.6376
	0.64865	•	•		•						0.65866,	0.65966,	0.66066,	0.6616
6,	0.66266, 0.67267	0.66366, 0.67367,	0.66466, 0.67467,	0.66567, 0.67568,	0.66667, 0.67668,	0.66767, 0.67768,	0.66867, 0.67868,	0.66967, 0.67968,	0.67067, 0.68068,	0.67167, , 0.68168,	0.68268,	0.68368,	0.68468,	0.6856
9,	0.68669,	0.68769,	0.68869,	0.68969,	0.69069,	0.69169,	0.69269,	0.69369,	0.69469,	0.6957,	0 70074	0 70774	0 70071	0 7007
1,	0.6967, 0.71071,	, 0.6977, 0.71171,	0.6987, 0.71271,	0.6997, 0.71371,		0.7017, 0.71572,	0.7027, 0.71672,	0.7037, 0.71772,	0.7047, 0.71872,	, 0.70571, 0.71972,	0.70671,	0.70771,	0.70871,	0.7097
-	0.72072	0.72172,	0.72272,	0.72372,	0.72472,	0.72573,	0.72673,	0.72773,	0.72873	0.72973,	0.73073,	0.73173,	0.73273,	0.7337
3,	0.73473, 0.74474	0.73574, , 0.74575,	0.73674, 0.74675,	0.73774, 0.74775,		0.73974, 0.74975,	0.74074, 0.75075,	0.74174, 0.75175,	0.74274, 0.75275,	0.74374, , 0.75375,	0.75475,	0.75576,	0.75676,	0.7577
6,	0.75876,	0.75976,	0.76076,	0.76176,	0.76276,	0.76376,	0.76476,	0.76577,	0.76677,	0.76777,	·	•	•	
8,	0.78278,	, 0.76977, 0.78378,			0.77277, 0.78679,				0.79079,	, 0.77778, 0.79179,	0.77878,	0.77978,	0.78078,	0.7817
	-													

```
0.7988,
                                         0.7958,
                                                   0.7968,
                                                              0.7978,
                   0.79379,
                                                                                   0.7998,
                                                                                             0.8008,
                                                                                                                  0.8028,
                                                                                                                             0.8038,
                                                                                                                                       0.8048,
                                                                                                                                                 0.8058
                              0.79479,
      0.80681, 0.80781, 0.80881, 0.80981, 0.81081, 0.81181, 0.81281, 0.81381, 0.81481, 0.81582,
1,
                  0.81782, 0.81882, 0.81982, 0.82082, 0.82182, 0.82282, 0.82382, 0.82482, 0.82583,
                                                                                                                            0.82783,
                                                                                                                                       0.82883,
                                                                                                                                                 0.8298
         0.81682,
                                                                                                                  0.82683,
3,
      0.83083.
              0.83183, 0.83283, 0.83383, 0.83483, 0.83584, 0.83684, 0.83784, 0.83884, 0.83984,
                  0.84184, 0.84284, 0.84384, 0.84484, 0.84585, 0.84685, 0.84785, 0.84885, 0.84985,
                                                                                                                                       0.85285,
                                                                                                                                                 0.8538
         0.84084,
                                                                                                                  0.85085,
                                                                                                                            0.85185,
      0.85485,
                0.85586,
                          0.85686, 0.85786, 0.85886, 0.85986, 0.86086, 0.86186, 0.86286, 0.86386,
5,
                   0.86587,
                             0.86687, 0.86787, 0.86887, 0.86987, 0.87087, 0.87187,
                                                                                            0.87287,
         0.86486,
                                                                                                                  0.87487,
                                                                                                                            0.87588,
                                                                                                                                       0.87688,
                                                                                                                                                 0.8778
                                     0.88188, 0.88288, 0.88388,
                                                                 0.88488, 0.88589, 0.88689, 0.88789,
8,
      0.87888,
                0.87988,
                          0.88088,
         0.88889,
                   0.88989,
                          0.89089, 0.89189, 0.89289, 0.89389, 0.89489, 0.8959, 0.8969, 0.8979,
                                                                                                                  0.8989.
                                                                                                                             0.8999,
                                                                                                                                       0.9009,
                                                                                                                                                  0.901
                                             0.90691, 0.90791,
                 0.9039,
                           0.9049,
                                     0.90591,
                                                                    0.90891, 0.90991, 0.91091, 0.91191,
      0.9029,
                   0.91391, 0.91491, 0.91592, 0.91692, 0.91792, 0.91892, 0.91992, 0.92092,
                                                                                                                                                 0.9259
         0.91291,
                                                                                                       0.92192.
                                                                                                                  0.92292.
                                                                                                                            0.92392,
                                                                                                                                       0.92492,
                          0.92893, 0.92993,
                                            0.93093, 0.93193,
                                                                    0.93293, 0.93393, 0.93493, 0.93594,
3,
      0.92693,
                0.92793,
                   0.93794, 0.93894, 0.93994, 0.94094, 0.94194,
                                                                       0.94294, 0.94394, 0.94494,
                                                                                                                  0.94695,
                                                                                                                            0.94795,
                                                                                                                                       0.94895,
                                                                                                                                                 0.9499
                0.95195, 0.95295, 0.95395, 0.95495, 0.95596,
                                                                    0.95696, 0.95796, 0.95896, 0.95996,
5,
                   0.96196, 0.96296, 0.96396, 0.96496, 0.96597, 0.96697, 0.96797, 0.96897, 0.96997,
         0.96096,
                                                                                                                  0.97097,
                                                                                                                            0.97197,
                                                                                                                                       0.97297,
                                                                                                                                                 0.9739
7,
               0.97598, 0.97698, 0.97798, 0.97898, 0.97998, 0.98098, 0.98198, 0.98298, 0.98398,
      0.97497,
         0.98498,
                   0.98599, 0.98699, 0.98799, 0.98899, 0.98999,
                                                                       0.99099, 0.99199, 0.99299,
                                                                                                                  0.99499.
                                                                                                                              0.996,
                                                                                                                                        0.997,
                                                                                                                                                  0.99
       0.999.
                   1]), array([[ 0.012433, 0.012433, 0.013729, ...,
                                                                       1,
                                                                                               1],
8,
                                                                                  1,
                             0.015147, ...,
                                                                       1],
      [ 0.012896.
                   0.012898.
                                                 1,
                                                            1,
                                                                       1],
      [ 0.025243,
                   0.025243,
                             0.041368, ...,
                                                  1,
                                                            1,
      [ 0.0081301,
                             0.013909, ...,
                  0.0081301,
                                                 1,
                                                            1,
                                                                       1],
                            0.016244, ...,
                                                1,
1,
        0.010033,
                   0.010033,
                                                            1,
                                                                       1],
                   0.04065, 0.079317, ...,
                                                            1,
                                                                       1]]), 'Confidence', 'Precision'], [array([
      [ 0.04065,
                                                                                                                 0, 0.001001,
                                                                                                                                0.002002, 0.003003,
0.004004, 0.005005, 0.006006, 0.007007, 0.008008, 0.009009, 0.01001, 0.011011, 0.012012, 0.013013, 0.014014,
                                                                                                                  0.015015, 0.016016,
                                                                                                                                       0.017017, 0.01
8018, 0.019019, 0.02002, 0.021021, 0.022022, 0.023023,
        0.024024, 0.025025, 0.026026, 0.027027, 0.028028, 0.029029, 0.03003, 0.031031, 0.032032, 0.033033,
                                                                                                                 0.034034.
                                                                                                                            0.035035,
                                                                                                                                      0.036036,
                                                                                                                                                0.03703
     0.038038, 0.039039, 0.04004, 0.041041, 0.042042, 0.043043, 0.044044, 0.045045, 0.046046, 0.047047,
        0.048048,
                  0.049049, 0.05005, 0.051051, 0.052052, 0.053053, 0.054054, 0.055055, 0.056056, 0.057057,
                                                                                                                 0.058058.
                                                                                                                           0.059059,
                                                                                                                                       0.06006,
                                                                                                                                                0.06106
               0.063063, 0.064064, 0.065065, 0.066066, 0.067067, 0.068068, 0.069069, 0.07007, 0.071071,
     0.062062,
        0.072072,
                  0.073073, 0.074074, 0.075075, 0.076076, 0.077077, 0.078078, 0.079079,
                                                                                            0.08008,
                                                                                                                 0.082082,
                                                                                                                            0.083083,
                                                                                                                                      0.084084,
                                                                                                                                                0.08508
               0.087087, 0.088088, 0.089089, 0.09009, 0.091091, 0.092092, 0.093093, 0.094094, 0.095095,
     0.086086,
5,
        0.096096, 0.097097, 0.098098, 0.099099, 0.1001, 0.1011, 0.1021, 0.1031, 0.1041, 0.10511,
                                                                                                                  0.10611,
                                                                                                                            0.10711,
                                                                                                                                       0.10811,
                                                                                                                                                 0.1091
                          0.11211, 0.11311, 0.11411, 0.11512, 0.11612, 0.11712, 0.11812, 0.11912,
      0.11011,
                0.11111,
1,
                   0.12112, 0.12212, 0.12312, 0.12412, 0.12513, 0.12613, 0.12713, 0.12813,
                                                                                                       0.12913.
                                                                                                                                                 0.1331
         0.12012,
                                                                                                                  0.13013.
                                                                                                                            0.13113,
                                                                                                                                       0.13213,
                                             0.13814, 0.13914, 0.14014, 0.14114,
3,
                0.13514,
                          0.13614,
                                     0.13714,
                                                                                         0.14214,
                                                                                                   0.14314.
                   0.14515, 0.14615, 0.14715, 0.14815, 0.14915, 0.15015, 0.15115, 0.15215,
                                                                                                                  0.15415.
                                                                                                                            0.15516,
                                                                                                                                       0.15616,
                                                                                                                                                 0.1571
                        0.16016, 0.16116, 0.16216, 0.16316, 0.16416, 0.16517, 0.16617, 0.16717,
6,
      0.15816,
               0.15916,
                  0.16917, 0.17017, 0.17117, 0.17217, 0.17317, 0.17417, 0.17518, 0.17618, 0.17718,
         0.16817,
                                                                                                                  0.17818,
                                                                                                                            0.17918,
                                                                                                                                       0.18018,
                                                                                                                                                 0.1811
      0.18218,
               0.18318,
                          0.18418, 0.18519, 0.18619, 0.18719, 0.18819, 0.18919, 0.19019, 0.19119,
8,
                          0.19419, 0.1952, 0.1962, 0.1972, 0.1982, 0.1992, 0.2002, 0.2012,
         0.19219,
                  0.19319,
                                                                                                                  0.2022,
                                                                                                                             0.2032,
                                                                                                                                       0.2042,
                                                                                                                                                 0.2052
                0.20721,
                          0.20821,
                                     0.20921,
                                               0.21021, 0.21121, 0.21221,
                                                                               0.21321,
                                                                                         0.21421,
                                                                                                   0.21522,
1,
      0.20621,
         0.21622,
                   0.21722,
                           0.21822, 0.21922,
                                                0.22022, 0.22122, 0.22222,
                                                                                  0.22322,
                                                                                            0.22422,
                                                                                                      0.22523,
                                                                                                                                       0.22823,
                                                                                                                                                 0.2292
                                                                                                                  0.22623,
                                                                                                                            0.22723,
                                     0.23323, 0.23423, 0.23524, 0.23624, 0.23724, 0.23824, 0.23924,
3,
      0.23023.
                0.23123,
                          0.23223,
                   0.24124, 0.24224, 0.24324, 0.24424, 0.24525, 0.24625,
                                                                                  0.24725, 0.24825, 0.24925,
         0.24024,
                                                                                                                  0.25025,
                                                                                                                            0.25125,
                                                                                                                                       0.25225.
                                                                                                                                                 0.2532
                                                                                       0.26226,
                0.25526,
                                     0.25726,
                                             0.25826, 0.25926,
                                                                  0.26026,
      0.25425,
                          0.25626,
                                                                            0.26126,
                                                                                                  0.26326,
5,
                   0.26527, 0.26627, 0.26727, 0.26827, 0.26927, 0.27027, 0.27127, 0.27227, 0.27327,
                                                                                                                                                 0.2772
         0.26426,
                                                                                                                  0.27427,
                                                                                                                            0.27528,
                                                                                                                                       0.27628,
8,
                0.27928,
                          0.28028,
                                     0.28128,
                                             0.28228, 0.28328, 0.28428, 0.28529, 0.28629, 0.28729,
         0.28829, 0.28929, 0.29029, 0.29129, 0.29229, 0.29329, 0.29429, 0.2953, 0.2963,
                                                                                                        0.2973,
                                                                                                                  0.2983,
                                                                                                                             0.2993,
                                                                                                                                       0.3003,
                                                                                                                                                  0.301
                                     0.30531,
3,
      0.3023,
                 0.3033,
                           0.3043,
                                             0.30631, 0.30731, 0.30831, 0.30931, 0.31031, 0.31131,
                           0.31431, 0.31532, 0.31632, 0.31732, 0.31832, 0.31932, 0.32032, 0.32132,
                                                                                                                                                 0.3253
         0.31231,
                   0.31331,
                                                                                                                  0.32232,
                                                                                                                            0.32332,
                                                                                                                                       0.32432,
      0.32633.
                0.32733,
                          0.32833,
                                     0.32933,
                                               0.33033, 0.33133, 0.33233, 0.33333,
                                                                                         0.33433,
                                                                                                   0.33534,
3,
                   0.33734,
                            0.33834,
                                                  0.34034, 0.34134,
                                                                       0.34234, 0.34334,
                                                                                            0.34434,
                                                                                                      0.34535,
         0.33634,
                                        0.33934,
                                                                                                                  0.34635,
                                                                                                                            0.34735,
                                                                                                                                       0.34835.
                                                                                                                                                 0.3493
                0.35135,
                          0.35235,
                                     0.35335,
                                               0.35435,
                                                          0.35536,
                                                                    0.35636,
                                                                               0.35736,
                                                                                         0.35836,
5,
                                                             0.36537,
                   0.36136,
                                                                                                       0.36937,
                                                                                                                                                 0.3733
         0.36036,
                             0.36236,
                                        0.36336,
                                                  0.36436,
                                                                       0.36637,
                                                                                  0.36737,
                                                                                            0.36837,
                                                                                                                  0.37037,
                                                                                                                            0.37137,
                                                                                                                                       0.37237,
                0.37538,
                          0.37638,
                                     0.37738,
                                               0.37838,
                                                       0.37938,
                                                                    0.38038,
                                                                               0.38138,
                                                                                         0.38238,
                                                                                                   0.38338,
      0.37437,
                          0.38639,
                                                                       0.39039,
                   0.38539,
                                                             0.38939,
                                                                                  0.39139,
         0.38438,
                                        0.38739,
                                                  0.38839,
                                                                                            0.39239,
                                                                                                       0.39339,
                                                                                                                  0.39439,
                                                                                                                             0.3954,
                                                                                                                                       0.3964,
                                                                                                                                                  0.397
      0.3984,
                 0.3994,
                           0.4004,
                                     0.4014,
                                                0.4024,
                                                           0.4034,
                                                                     0.4044,
                                                                               0.40541,
                                                                                         0.40641,
                                                                                                   0.40741,
4,
                                                                       0.41441,
                                                             0.41341,
         0.40841,
                   0.40941, 0.41041, 0.41141, 0.41241,
                                                                                            0.41642,
                                                                                                       0.41742,
                                                                                                                  0.41842,
                                                                                                                                                 0.4214
                                                                                  0.41542,
                                                                                                                            0.41942,
                                                                                                                                       0.42042,
2,
      0.42242,
                0.42342,
                          0.42442,
                                     0.42543, 0.42643, 0.42743, 0.42843, 0.42943,
                                                                                         0.43043, 0.43143,
                  0.43343, 0.43443, 0.43544, 0.43644, 0.43744, 0.43844, 0.43944, 0.44044,
                                                                                                       0.44144,
                                                                                                                                                 0.4454
         0.43243,
                                                                                                                  0.44244,
                                                                                                                            0.44344,
                                                                                                                                       0.44444,
      0.44645,
                0.44745,
                          0.44845,
                                     0.44945, 0.45045, 0.45145,
                                                                  0.45245,
                                                                            0.45345, 0.45445, 0.45546,
                                     0.45946,
                  0.45746,
                            0.45846,
                                                0.46046, 0.46146,
                                                                    0.46246, 0.46346, 0.46446,
         0.45646,
                                                                                                    0.46547.
                                                                                                                  0.46647,
                                                                                                                            0.46747,
                                                                                                                                       0.46847,
                                                                                                                                                 0.4694
                0.47147,
      0.47047,
                          0.47247,
                                     0.47347,
                                               0.47447, 0.47548,
                                                                    0.47648,
                                                                               0.47748,
                                                                                         0.47848,
                                                                                                   0.47948,
7,
                            0.48248,
                                                  0.48448,
                                                                                  0.48749,
                                                                                            0.48849, 0.48949,
                                                                                                                                                 0.4934
         0.48048,
                  0.48148,
                                        0.48348,
                                                             0.48549,
                                                                       0.48649,
                                                                                                                  0.49049,
                                                                                                                            0.49149,
                                                                                                                                       0.49249,
9,
      0.49449,
                 0.4955,
                           0.4965,
                                      0.4975,
                                                0.4985,
                                                           0.4995,
                                                                     0.5005,
                                                                                0.5015,
                                                                                          0.5025,
                                                                                                     0.5035,
```

```
0.50751,
                                                                                                                         0.51251,
                                                                                                                                                                                              0.5175
            0.5045,
                         0.50551,
                                       0.50651,
                                                                  0.50851,
                                                                                0.50951,
                                                                                              0.51051,
                                                                                                           0.51151,
                                                                                                                                       0.51351,
                                                                                                                                                    0.51451,
                                                                                                                                                                  0.51552,
                                                                                                                                                                                0.51652,
       0.51852,
                                                              0.52252,
                                                                           0.52352,
                                                                                                       0.52553,
2,
                     0.51952,
                                  0.52052,
                                                0.52152,
                                                                                         0.52452,
                                                                                                                    0.52653,
                                                                                                                                  0.52753,
                                                                                                                                                                                             0.5415
           0.52853,
                         0.52953,
                                       0.53053,
                                                    0.53153,
                                                                  0.53253,
                                                                               0.53353,
                                                                                             0.53453,
                                                                                                           0.53554,
                                                                                                                         0.53654,
                                                                                                                                       0.53754,
                                                                                                                                                    0.53854,
                                                                                                                                                                  0.53954,
                                                                                                                                                                                0.54054,
       0.54254,
                     0.54354,
                                  0.54454,
                                                0.54555,
                                                              0.54655,
                                                                            0.54755,
                                                                                         0.54855,
                                                                                                       0.54955,
                                                                                                                     0.55055,
                                                                                                                                  0.55155,
4,
                         0.55355,
                                                                               0.55756,
           0.55255,
                                       0.55455,
                                                    0.55556,
                                                                  0.55656,
                                                                                             0.55856,
                                                                                                           0.55956,
                                                                                                                         0.56056,
                                                                                                                                       0.56156,
                                                                                                                                                    0.56256,
                                                                                                                                                                  0.56356,
                                                                                                                                                                                0.56456,
                                                                                                                                                                                             0.5655
                                                                                                                                  0.57558,
       0.56657,
                     0.56757,
                                  0.56857,
                                                0.56957,
                                                              0.57057,
                                                                            0.57157,
                                                                                         0.57257,
                                                                                                       0.57357,
                                                                                                                     0.57457,
7,
           0.57658,
                         0.57758,
                                       0.57858,
                                                    0.57958,
                                                                  0.58058,
                                                                                0.58158,
                                                                                              0.58258,
                                                                                                           0.58358,
                                                                                                                         0.58458,
                                                                                                                                       0.58559,
                                                                                                                                                                                0.58859,
                                                                                                                                                                                              0.5895
                                                                                                                                                    0.58659,
                                                                                                                                                                  0.58759,
9,
       0.59059,
                     0.59159,
                                  0.59259,
                                                0.59359,
                                                              0.59459,
                                                                            0.5956,
                                                                                          0.5966,
                                                                                                        0.5976,
                                                                                                                      0.5986,
                                                                                                                                   0.5996,
            0.6006,
                                                                                0.60561,
                                                                                                                                       0.60961,
                                                                                                                                                                                             0.6136
                          0.6016,
                                        0.6026,
                                                     0.6036,
                                                                   0.6046,
                                                                                              0.60661,
                                                                                                           0.60761,
                                                                                                                         0.60861,
                                                                                                                                                    0.61061,
                                                                                                                                                                  0.61161,
                                                                                                                                                                                0.61261,
       0.61461,
                     0.61562,
                                  0.61662,
                                                0.61762,
                                                              0.61862,
                                                                            0.61962,
                                                                                         0.62062,
                                                                                                       0.62162,
                                                                                                                     0.62262,
                                                                                                                                  0.62362,
1,
                                                                                0.62963,
                                                                                             0.63063,
                                                                                                           0.63163,
           0.62462,
                         0.62563,
                                                    0.62763,
                                                                  0.62863,
                                                                                                                         0.63263,
                                                                                                                                       0.63363,
                                                                                                                                                    0.63463,
                                                                                                                                                                                0.63664,
                                                                                                                                                                                             0.6376
                                       0.62663,
                                                                                                                                                                  0.63564,
                                  0.64064,
       0.63864,
                     0.63964,
                                                0.64164,
                                                              0.64264,
                                                                            0.64364,
                                                                                         0.64464,
                                                                                                       0.64565,
                                                                                                                    0.64665,
                                                                                                                                  0.64765,
4,
           0.64865,
                         0.64965,
                                       0.65065,
                                                    0.65165,
                                                                  0.65265,
                                                                                0.65365,
                                                                                              0.65465,
                                                                                                           0.65566,
                                                                                                                         0.65666,
                                                                                                                                       0.65766,
                                                                                                                                                    0.65866,
                                                                                                                                                                  0.65966,
                                                                                                                                                                                0.66066,
                                                                                                                                                                                              0.6616
                     0.66366,
                                                                                                                    0.67067,
       0.66266,
                                  0.66466,
                                                0.66567,
                                                              0.66667,
                                                                           0.66767,
                                                                                         0.66867,
                                                                                                       0.66967,
                                                                                                                                  0.67167,
6,
                                                                                                                                                    0.68268,
                                                                                                                                                                  0.68368,
                                                                                                                                                                                0.68468,
                                                                                                                                                                                              0.6856
           0.67267,
                         0.67367,
                                       0.67467,
                                                    0.67568,
                                                                  0.67668,
                                                                               0.67768,
                                                                                             0.67868,
                                                                                                           0.67968,
                                                                                                                         0.68068,
                                                                                                                                       0.68168,
9,
       0.68669,
                     0.68769,
                                  0.68869,
                                                0.68969,
                                                              0.69069,
                                                                           0.69169,
                                                                                         0.69269,
                                                                                                       0.69369,
                                                                                                                     0.69469,
                                                                                                                                   0.6957,
                          0.6977,
                                       0.6987,
                                                     0.6997,
                                                                   0.7007,
                                                                                 0.7017,
                                                                                              0.7027,
                                                                                                            0.7037,
                                                                                                                          0.7047,
                                                                                                                                       0.70571,
                                                                                                                                                    0.70671,
                                                                                                                                                                  0.70771,
                                                                                                                                                                                0.70871,
                                                                                                                                                                                             0.7097
            0.6967,
                                  0.71271,
                                                0.71371,
                                                              0.71471,
                                                                            0.71572,
                                                                                         0.71672,
                                                                                                                     0.71872,
       0.71071,
                     0.71171,
                                                                                                       0.71772,
                                                                                                                                  0.71972,
1,
                                                    0.72372,
                                                                                0.72573,
                                                                                                           0.72773,
                                       0.72272,
                                                                                              0.72673,
                                                                                                                                                                                             0.7337
            0.72072,
                         0.72172,
                                                                  0.72472,
                                                                                                                         0.72873,
                                                                                                                                       0.72973.
                                                                                                                                                    0.73073,
                                                                                                                                                                  0.73173,
                                                                                                                                                                                0.73273,
                                                                                                       0.74174,
       0.73473,
                     0.73574,
                                  0.73674,
                                                0.73774,
                                                              0.73874,
                                                                            0.73974,
                                                                                         0.74074,
                                                                                                                     0.74274,
                                                                                                                                  0.74374,
3,
                                       0.74675,
                                                                                                                                       0.75375,
                                                                                                                                                                                             0.7577
           0.74474,
                         0.74575,
                                                    0.74775,
                                                                  0.74875,
                                                                                0.74975,
                                                                                             0.75075,
                                                                                                           0.75175,
                                                                                                                         0.75275,
                                                                                                                                                    0.75475,
                                                                                                                                                                                0.75676,
                                                                                                                                                                  0.75576,
       0.75876,
                     0.75976,
                                  0.76076,
                                                0.76176,
                                                              0.76276,
                                                                            0.76376,
                                                                                         0.76476,
                                                                                                       0.76577,
                                                                                                                     0.76677,
                                                                                                                                  0.76777,
6,
                                                    0.77177,
                                                                  0.77277,
                                                                                                                         0.77678,
                                                                                             0.77477,
                                                                                                           0.77578,
                                                                                                                                       0.77778,
                                                                                                                                                                                             0.7817
           0.76877,
                         0.76977,
                                       0.77077,
                                                                                0.77377,
                                                                                                                                                    0.77878,
                                                                                                                                                                  0.77978,
                                                                                                                                                                                0.78078,
8,
       0.78278,
                     0.78378,
                                  0.78478,
                                                0.78579,
                                                              0.78679,
                                                                            0.78779,
                                                                                         0.78879,
                                                                                                       0.78979,
                                                                                                                    0.79079,
                                                                                                                                  0.79179,
           0.79279,
                         0.79379,
                                       0.79479,
                                                     0.7958,
                                                                   0.7968,
                                                                                 0.7978,
                                                                                               0.7988,
                                                                                                            0.7998,
                                                                                                                          0.8008,
                                                                                                                                        0.8018,
                                                                                                                                                     0.8028,
                                                                                                                                                                                 0.8048,
                                                                                                                                                                                             0.8058
                                                                                                                                                                   0.8038,
                                                              0.81081,
       0.80681,
                                  0.80881,
                                                0.80981,
                                                                           0.81181,
                                                                                         0.81281,
                                                                                                       0.81381,
1,
                     0.80781,
                                                                                                                    0.81481,
                                                                                                                                  0.81582,
                                                                                                                                                                                              0.8298
           0.81682,
                         0.81782,
                                       0.81882,
                                                    0.81982,
                                                                  0.82082,
                                                                               0.82182,
                                                                                             0.82282,
                                                                                                           0.82382,
                                                                                                                         0.82482,
                                                                                                                                       0.82583.
                                                                                                                                                    0.82683,
                                                                                                                                                                  0.82783,
                                                                                                                                                                                0.82883,
3,
       0.83083.
                     0.83183,
                                  0.83283,
                                                0.83383,
                                                              0.83483,
                                                                           0.83584,
                                                                                         0.83684,
                                                                                                       0.83784,
                                                                                                                     0.83884,
                                                                                                                                  0.83984.
           0.84084,
                                       0.84284,
                                                    0.84384,
                                                                  0.84484,
                                                                               0.84585,
                                                                                             0.84685,
                                                                                                           0.84785,
                                                                                                                                      0.84985,
                                                                                                                                                                                0.85285,
                                                                                                                                                                                             0.8538
                         0.84184,
                                                                                                                         0.84885,
                                                                                                                                                    0.85085,
                                                                                                                                                                  0.85185,
                                                                            0.85986,
       0.85485,
                     0.85586,
                                  0.85686,
                                                0.85786,
                                                              0.85886,
                                                                                         0.86086,
                                                                                                       0.86186,
                                                                                                                     0.86286,
                                                                                                                                  0.86386,
5,
                         0.86587,
                                                                  0.86887,
                                                                                                                         0.87287,
           0.86486,
                                       0.86687,
                                                    0.86787,
                                                                                0.86987,
                                                                                              0.87087,
                                                                                                           0.87187,
                                                                                                                                       0.87387,
                                                                                                                                                    0.87487,
                                                                                                                                                                  0.87588,
                                                                                                                                                                                0.87688,
                                                                                                                                                                                              0.8778
       0.87888,
                     0.87988,
                                  0.88088,
                                                0.88188,
                                                              0.88288,
                                                                           0.88388,
                                                                                         0.88488,
                                                                                                       0.88589,
                                                                                                                     0.88689,
                                                                                                                                  0.88789,
8,
                         0.88989,
                                                                                             0.89489,
                                                                                                                                        0.8979,
                                                                                                                                                     0.8989,
                                                                                                                                                                                 0.9009,
                                                                                                                                                                                              0.901
           0.88889,
                                       0.89089,
                                                    0.89189,
                                                                  0.89289,
                                                                                0.89389,
                                                                                                            0.8959,
                                                                                                                          0.8969,
                                                                                                                                                                   0.8999,
        0.9029,
                      0.9039,
                                   0.9049,
                                                0.90591,
                                                              0.90691,
                                                                            0.90791,
                                                                                         0.90891,
                                                                                                       0.90991,
                                                                                                                     0.91091,
                                                                                                                                  0.91191,
9,
                                                                                                                                                                                              0.9259
           0.91291,
                         0.91391,
                                       0.91491,
                                                    0.91592,
                                                                  0.91692,
                                                                                0.91792,
                                                                                              0.91892,
                                                                                                           0.91992,
                                                                                                                         0.92092,
                                                                                                                                       0.92192,
                                                                                                                                                    0.92292,
                                                                                                                                                                  0.92392,
                                                                                                                                                                                0.92492,
3,
       0.92693,
                     0.92793,
                                  0.92893,
                                                0.92993,
                                                              0.93093,
                                                                            0.93193,
                                                                                         0.93293,
                                                                                                       0.93393,
                                                                                                                     0.93493,
                                                                                                                                  0.93594.
                                                                  0.94094,
                                                                                0.94194,
                                                                                                                                                    0.94695,
                                                                                                                                                                                0.94895,
                                                                                                                                                                                              0.9499
           0.93694,
                         0.93794,
                                       0.93894,
                                                    0.93994,
                                                                                             0.94294,
                                                                                                           0.94394,
                                                                                                                         0.94494,
                                                                                                                                       0.94595.
                                                                                                                                                                  0.94795,
5,
       0.95095,
                     0.95195,
                                  0.95295,
                                                0.95395,
                                                              0.95495,
                                                                            0.95596,
                                                                                         0.95696,
                                                                                                       0.95796,
                                                                                                                    0.95896,
                                                                                                                                  0.95996,
                                                                  0.96496,
                                                    0.96396,
                                                                                             0.96697,
                                                                                                                         0.96897,
           0.96096,
                         0.96196,
                                       0.96296,
                                                                                0.96597,
                                                                                                           0.96797,
                                                                                                                                       0.96997,
                                                                                                                                                    0.97097,
                                                                                                                                                                  0.97197,
                                                                                                                                                                                0.97297,
                                                                                                                                                                                              0.9739
       0.97497,
                     0.97598,
                                  0.97698,
                                                0.97798,
                                                              0.97898,
                                                                           0.97998,
                                                                                         0.98098,
                                                                                                       0.98198,
                                                                                                                     0.98298,
                                                                                                                                  0.98398,
7,
           0.98498,
                         0.98599,
                                       0.98699,
                                                    0.98799,
                                                                  0.98899,
                                                                                0.98999,
                                                                                              0.99099,
                                                                                                           0.99199,
                                                                                                                         0.99299,
                                                                                                                                      0.99399,
                                                                                                                                                    0.99499,
                                                                                                                                                                    0.996,
                                                                                                                                                                                  0.997,
                                                                                                                                                                                               0.99
8,
         0.999,
                           1]), array([[
                                             0.98305,
                                                           0.98305,
                                                                        0.98305, ...,
                                                                                                  0,
                                                                                                                             0],
                                                                                                               0,
                          0.98974,
                                                                                            0],
            0.98974,
                                        0.98462, ...,
                                                                 0,
                                                                               0,
            0.92857,
                          0.92857,
                                        0.92857, ...,
                                                                                            0],
                                                                               0,
                0.75,
                             0.75,
                                           0.75, ...,
                                                                 0,
                                                                               0,
                                                                                            0],
                  1,
                                1,
                                              1, ...,
                                                                 0,
                                                                               0,
                                        0.83333, ...,
            0.83333,
                          0.83333,
                                                                                            0]]), 'Confidence', 'Recall']]
                                                                 0,
                                                                               0,
fitness: 0.5188837936017358
keys: ['metrics/precision(B)', 'metrics/recall(B)', 'metrics/mAP50(B)', 'metrics/mAP50-95(B)']
                                             0.54416,
                                                          0.86656,
                                                                      0.039794,
                                                                                     0.48923,
                                                                                                   0.37911,
maps: array([ 0.57597,
                             0.68196,
                                                                                                                   0.502,
                                                                                                                               0.44142,
                                                                                                                                               0.502,
                                                                                                                                                           0.49975])
names: {0: 'pickup_truck', 1: 'car', 2: 'articulated_truck', 3: 'bus', 4: 'motorized_vehicle', 5: 'work_van', 6: 'single_unit_truck', 7: 'pedestrian', 8: 'bicycle', 9: 'non_motorized_veh
icle', 10: 'motorcycle'}
plot: True
results_dict: {'metrics/precision(B)': 0.7600850933747962, 'metrics/recall(B)': 0.5873930307929995, 'metrics/mAP50(B)': 0.6708715091977615, 'metrics/mAP50-95(B)': 0.5019962696466218, 'fi
tness': 0.5188837936017358}
save_dir: PosixPath('runs/detect/train154')
speed: {'preprocess': 2.9239432565097148, 'inference': 396.81344278927503, 'loss': 8.714610132677802e-05, 'postprocess': 1.253045838454674}
task: 'detect'
```

1.5 Run Inferences on Sample Images

```
from PIL import Image, ImageDraw, ImageFont
         import numpy as np
In [21]: # Load the trained model
         model = YOLO('/Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/07 - Capstone/Autonomous Driving/runs/detect/train15/weights/best.pt')
In [22]: # Path to your sample images
         sample_images_path = '/Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/07 - Capstone/Autonomous Driving/sample_images'
         output_images_path = '/Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/07 - Capstone/Autonomous Driving/output_images'
         # Ensure the output directory exists
         os.makedirs(output images path, exist ok=True)
In [24]: # Run inference on the sample images
         results = model.predict(source=sample images path, save=True, save dir=output images path)
         # Function to draw bounding boxes on the image
         def draw boxes(image, boxes, labels, scores, class names):
             draw = ImageDraw.Draw(image)
             font = ImageFont.load default()
             for box, label, score in zip(boxes, labels, scores):
                 x1, y1, x2, y2 = box
                 draw.rectangle([x1, y1, x2, y2], outline="red", width=3)
                 draw.text((x1, y1), f"{class_names[label]} {score:.2f}", fill="red", font=font)
             return image
         # Class names based on your dataset.yaml
         class_names = ['pickup_truck', 'car', 'articulated_truck', 'bus', 'motorized_vehicle',
                         'work_van', 'single_unit_truck', 'pedestrian', 'bicycle', 'non_motorized_vehicle', 'motorcycle']
         # Display the results
         for result in results:
             img path = result.path
             img = Image.open(img path)
             # Retrieve boxes, labels, and scores
             boxes = result.boxes.xyxy.numpy() # Bounding box coordinates in (x1, y1, x2, y2) format
             labels = result.boxes.cls.numpy().astype(int) # Class labels
             scores = result.boxes.conf.numpy() # Confidence scores
             # Draw boxes on the image
             img_with_boxes = draw_boxes(img, boxes, labels, scores, class_names)
             # Display the image
             plt.figure(figsize=(10, 10))
             plt.imshow(img_with_boxes)
             plt.axis('off')
             plt.show()
         image 1/6 /Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/07 - Capstone/Autonomous Driving/sample_images/image1.jpeg: 544x640 7 cars, 6 work_vans, 435.6ms
         image 2/6 /Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/07 - Capstone/Autonomous Driving/sample_images/image2.jpeg: 416x640 1 pickup_truck, 10 cars, 1 bus, 341.7ms
         image 3/6 /Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/07 - Capstone/Autonomous Driving/sample_images/image3.jpeg: 480x640 4 pickup_trucks, 4 cars, 4 buss, 1 work_van,
         image 4/6 /Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/07 - Capstone/Autonomous Driving/sample_images/image4.jpeg: 448x640 3 pickup_trucks, 1 car, 2 articulated_truck
         s, 1 single unit truck, 344.7ms
         image 5/6 /Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/07 - Capstone/Autonomous Driving/sample_images/image5.jpeg: 384x640 3 pickup_trucks, 9 cars, 5 work_vans, 303.6m
         image 6/6 /Users/leethornquist/Desktop/AI:ML Caltech Bootcamp/Foundations/07 - Capstone/Autonomous Driving/sample_images/image6.jpeg: 448x640 3 buss, 430.4ms
         Speed: 4.4ms preprocess, 377.3ms inference, 1.4ms postprocess per image at shape (1, 3, 448, 640)
         Results saved to runs/detect/predict2
         <Figure size 1000x1000 with 1 Axes>
         <Figure size 1000x1000 with 1 Axes>
```

<Figure size 1000x1000 with 1 Axes>

I attached some examples of the image inferences. The model is very good with identifying cars but struggles with other categories.

Part 2 in separate file

In []: