Tensorflow-Tiled-Image-Segmentation-Pre-Augmented-IDRiD-OpticDisc (2025/03/19)

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This is the first experiment of Tiled Image Segmentation for IDRiD-OpticDisc based on the latest Tensorflow-Image-Segmentation-API, and a **pre-augmented tiled dataset** Augmented-Tiled-IDRiD-OpticDisc-ImageMask-Dataset.zip, which was derived by us from Segmentation dataset of **Indian Diabetic Retinopathy Image Dataset (IDRiD)**

Please see also Tensorflow-Tiled-Image-Segmentation-Pre-Augmented-IDRiD-HardExudates

Experiment Strategies
In this experiment, we employed the following strategies.
1. Create Tiled ImageMask Dataset
We created Tiled-IDRiD-OpticDisc-ImageMask-Dataset, which was tiledly-splitted to 512x512 pixels and reduced to 512x512 pixels image and mask dataset from the original 4288x2848 pixels images and mask files.

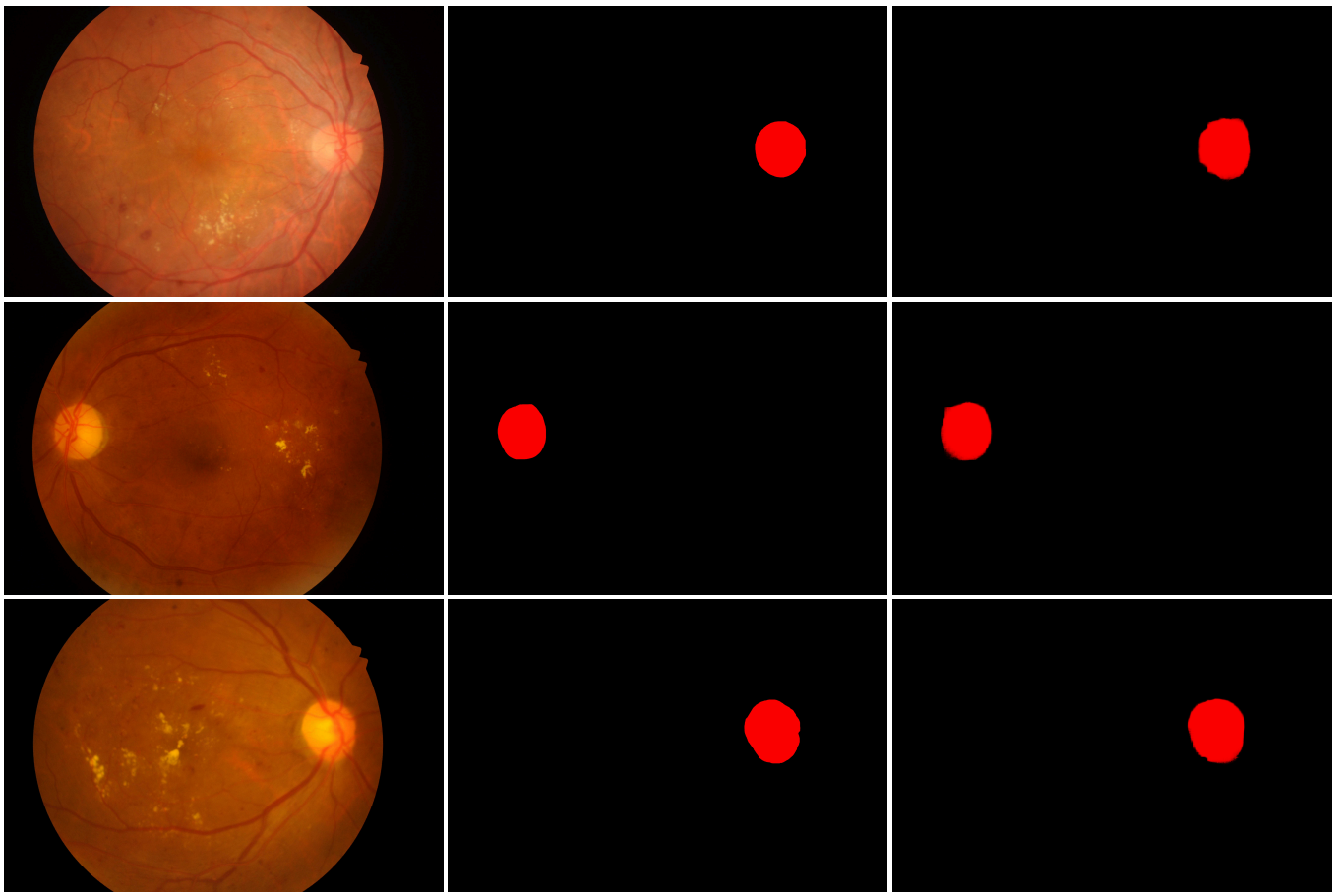
2. Train UNet Model by Tiled ImageMask Dataset
We trained and validated a TensorFlow UNet model using the Tiled-IDRiD-OpticDisc train and valid datasets.

3. Evaluate UNet Model performance
We evaluated a TensorFlow UNet model using the Tiled-IDRiD-OpticDisc test dataset

4. Apply Tiled Image Segmentation
We applied our Tiled-Image Segmentation inference method to predict the Optic Disc regions for the mini_test images with a resolution of 4288x2848 pixels.

Actual Tiled Image Segmentation for Images of 4288x2848 pixels
As shown below, the inferred masks look quite similar to the ground truth masks.

Input: image	Mask (ground_truth)	Prediction: inferred_mask



In this experiment, we used the simple UNet Model TensorflowSlightlyFlexibleUNet for this IDRiD-OpticDiscSegmentation Model.
As shown in Tensorflow-Image-Segmentation-API. you may try other Tensorflow UNet Models:

- TensorflowSwinUNet.py
- TensorflowMultiResUNet.py
- TensorflowAttentionUNet.py
- TensorflowEfficientUNet.py
- TensorflowUNet3Plus.py
- TensorflowDeepLabV3Plus.py

1. Dataset Citation

The dataset used here has been take from the following **IEEE DataPort** web site
Indian Diabetic Retinopathy Image Dataset (IDRiD)

Please see also **DIABETIC RETINOPATHY: SEGMENNTATION AND GRAND CHALLENGE**

Citation Author(s):
Prasanna Porwal, Samiksha Pachade, Ravi Kamble, Manesh Kokare, Girish Deshmukh,
Vivek Sahasrabuddhe, Fabrice Meriaudeau,
April 24, 2018, "Indian Diabetic Retinopathy Image Dataset (IDRiD)", IEEE Dataport,

DOI: https://dx.doi.org/10.21227/H25W98

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2 Augmented-Tiled-IDRiD-OpticDisc ImageMask Dataset

If you would like to train this IDRiD-OpticDisc Segmentation model by yourself, please download the pre-augmented dataset from the google drive Augmented-Tiled-IDRiD-OpticDisc-ImageMask-Dataset.zip, expand the downloaded ImageMaskDataset and put it under **./dataset** folder to be

```
./dataset
└─Augmented-Tiled-IDRiD-OpticDisc
    ├─test
    │  ├─images
    │  └─masks
    ├─train
    │  ├─images
    │  └─masks
    └─valid
       ├─images
       └─masks
```

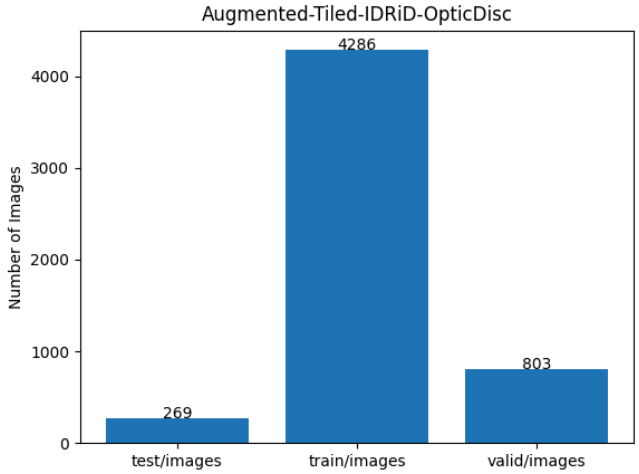
This is a 512x512 pixels pre augmented tiles dataset generated from 4288x2848 pixels 54 **Original Images** and their corresponding **Optic Disc GroundTruths** in Training Set.
.
We excluded all black (empty) masks and their corresponding images to generate our dataset from the original one.
The folder structure of the original Segmentation data is the following.

```
./A. Segmentation
├─1. Original Images
│  ├─a. Training Set
│  └─b. Testing Set
└─2. All Segmentation Groundtruths
   ├─a. Training Set
   │  ├─1. Microaneurysms
   │  ├─2. Haemorrhages
   │  ├─3. Hard Exudates
   │  ├─4. Soft Exudates
   │  └─5. Optic Disc
   └─b. Testing Set
      ├─1. Microaneurysms
      ├─2. Haemorrhages
      ├─3. Hard Exudates
      ├─4. Soft Exudates
      └─5. Optic Disc
```

On the derivation of this tiled dataset, please refer to the following Python scripts.

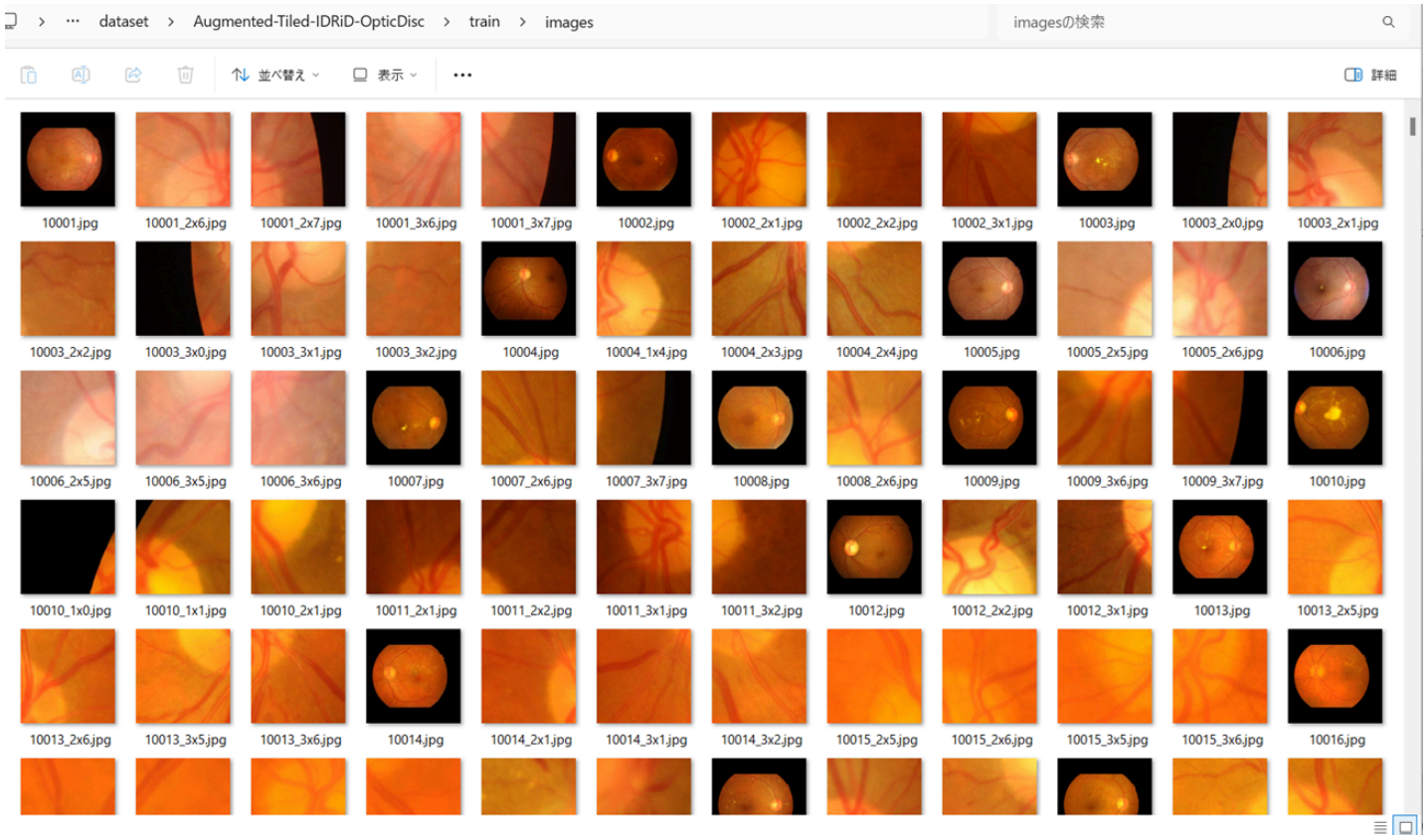
- TiledImageMaskDatasetGenerator.py
- split_tiled_master.py

Augmented-Tiled-IDRiD-OpticDisc Statistics

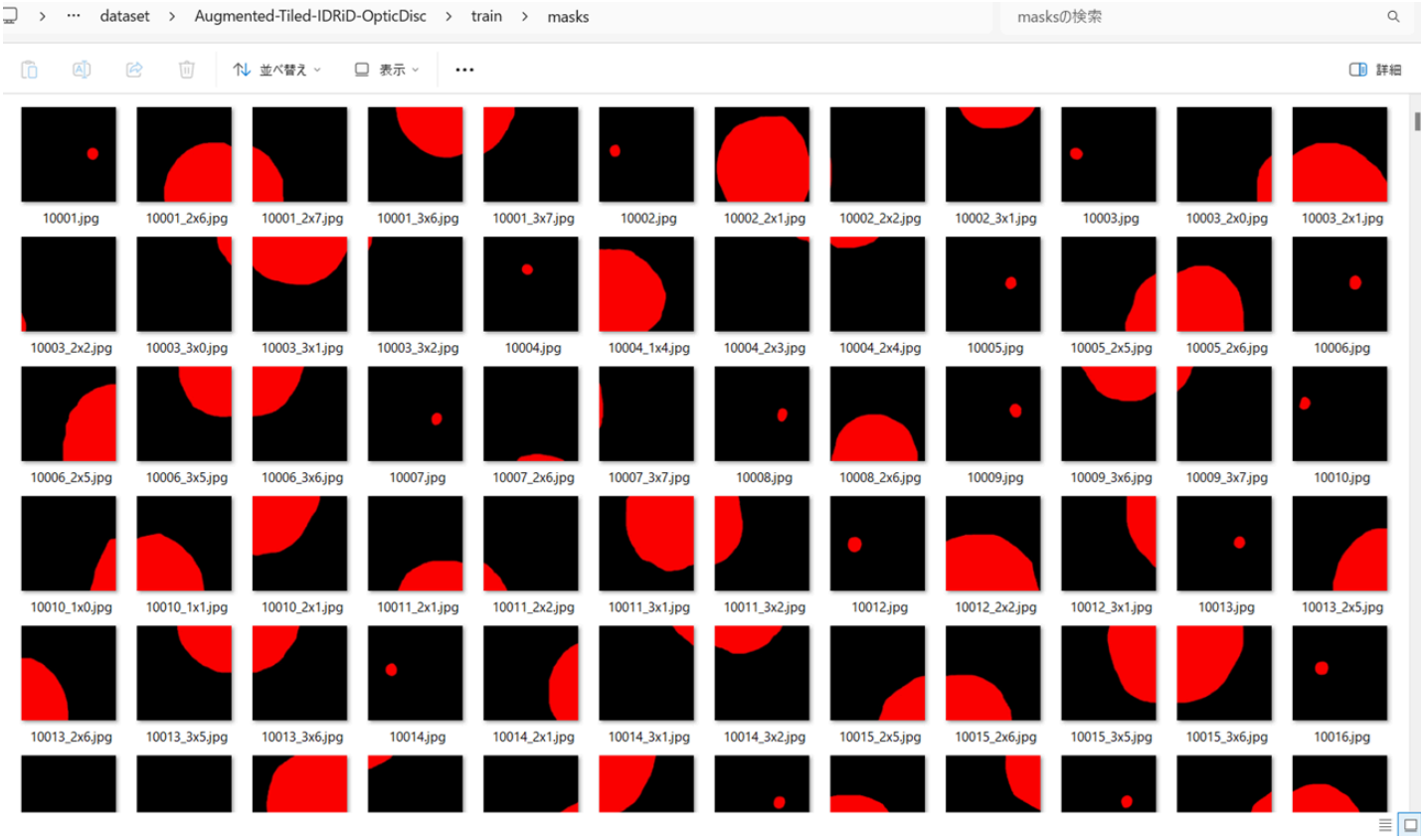


As shown above, the number of images of train and valid datasets is enough to use for a training set of our segmentation model.

Train_images_sample



Train_masks_sample



3 Train TensorflowUNet Model

We have trained IDRiD-OpticDisc TensorflowUNet Model by using the following **train_eval_infer.config** file.
Please move to ./projects/TensorflowSlightlyFlexibleUNet/IDRiD-OpticDiscand run the following bat file.

```
>1.train.bat
```

, which simply runs the following command.

```
>python ../../../src/TensorflowUNetTrainer.py ./train_eval_infer.config
```

Model parameters
Enabled Batch Normalization.
Defined a small **base_filters=16** and large **base_kernels=(9,9)** for the first Conv Layer of Encoder Block of TensorflowUNet.py and a large num_layers (including a bridge between Encoder and Decoder Blocks).

```
[model]
base_filters   = 16
base_kernels   = (9,9)
num_layers     = 8
dilation       = (3,3)
```

Learning rate
Defined a small learning rate.

```
[model]
learning_rate  = 0.00007
```

Online augmentation
Disabled our online augmentation tool.

```
[model]
model          = "TensorflowUNet"
generator      = False
```

Loss and metrics functions
Specified "bce_dice_loss" and "dice_coef".

```
[model]
loss           = "bce_dice_loss"
metrics        = ["dice_coef"]
```

Learning rate reducer callback
Enabled learing_rate_reducer callback, and a small reducer_patience.

```
[train]
learning_rate_reducer = True
reducer_factor     = 0.4
reducer_patience   = 4
```

Dataset class

Specified ImageMaskDataset class.

```
[dataset]
datasetclass  = "ImageMaskDataset"
resize_interpolation = "cv2.INTER_CUBIC"
```

Early stopping callback

Enabled early stopping callback with patience parameter.

```
[train]
patience      = 10
```

Epoch change inference callbacks

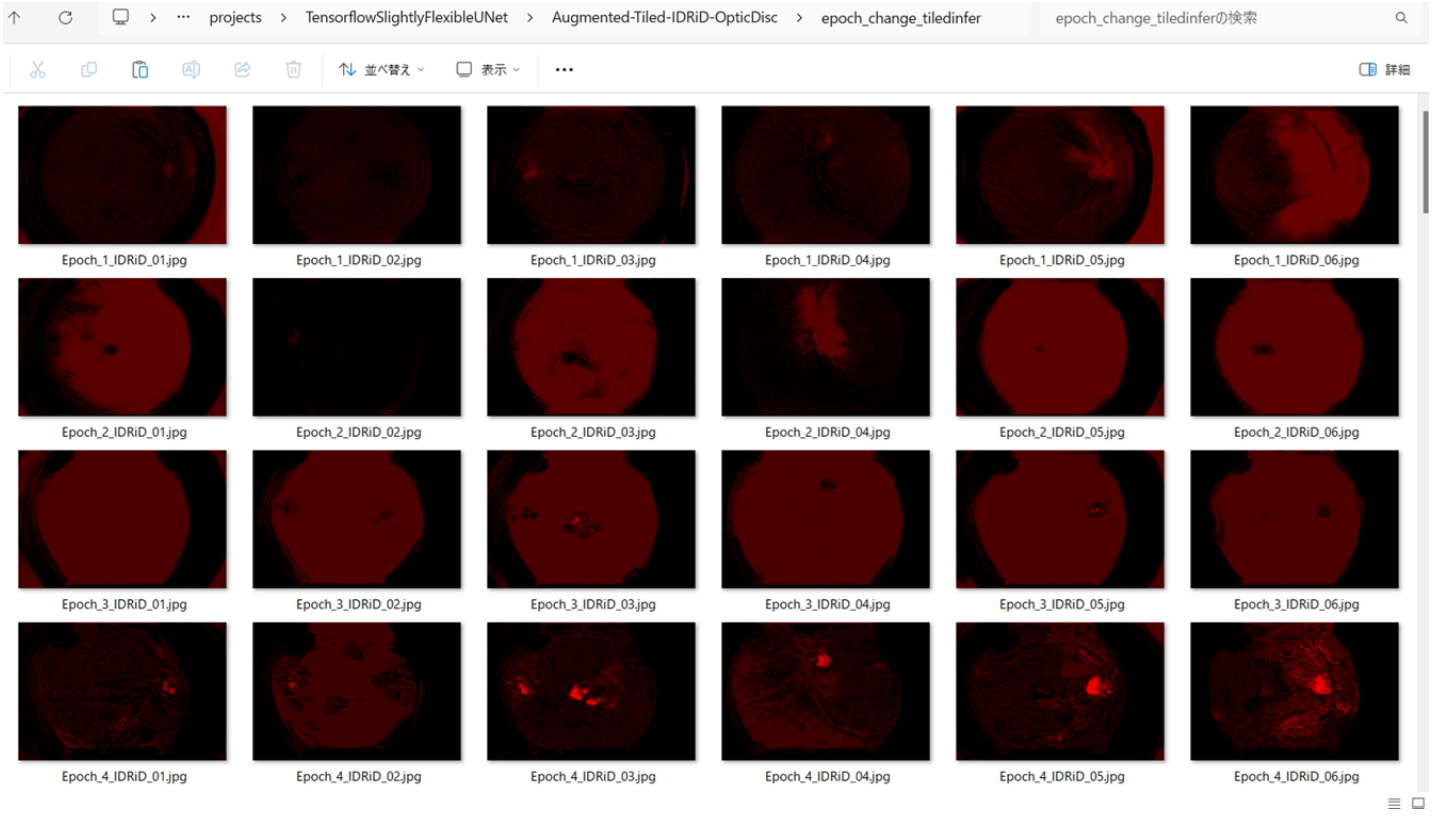
Enabled epoch_change_infer callback.

```
[train]

epoch_change_infer      = False
epoch_change_infer_dir  = "./epoch_change_infer"
epoch_change_tiledinfer = True
epoch_change_tiledinfer_dir = "./epoch_change_tiledinfer"
num_infer_images        = 6
```

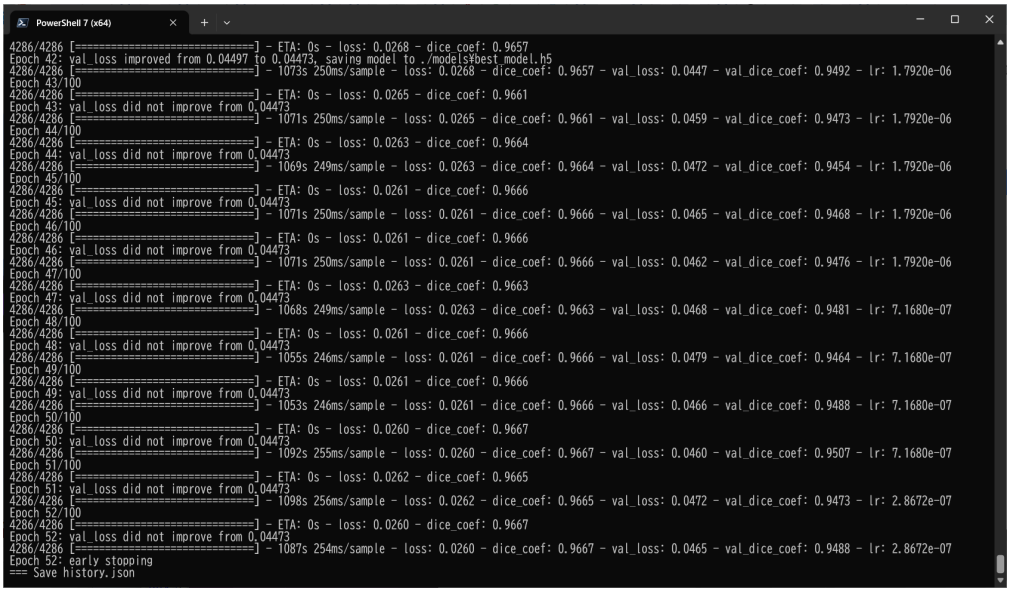
By using this callback, on every epoch_change, the epoch change tiledinfer procedure can be called for 6 image in **mini_test** folder. This will help you confirm how the predicted mask changes at each epoch during your training process.

Epoch_change_inference output at starting (1,2,3,4)

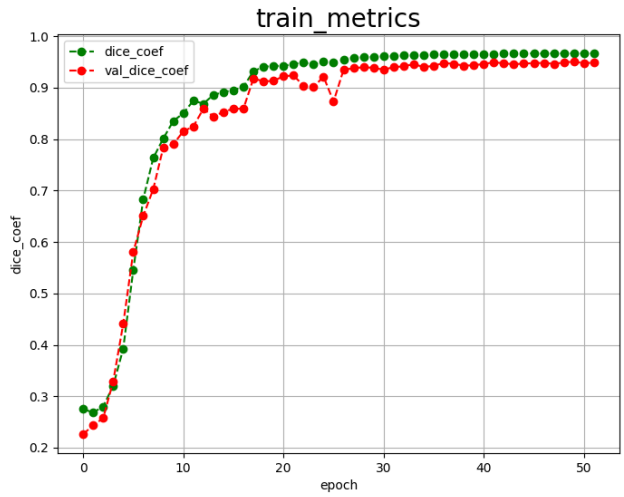


Epoch_change_inference output at ending (49,50,51,52)

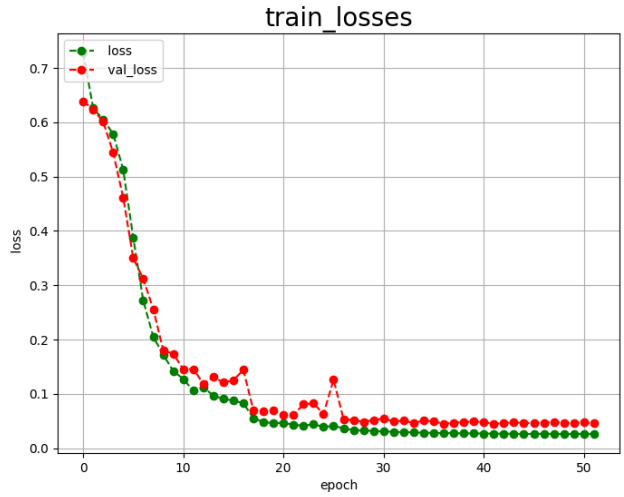
In this experiment, the training process was stopped at epoch 52 by EarlyStopping Callback.



train_metrics.csv



train_losses.csv



4 Evaluation

Please move to a **./projects/TensorflowSlightlyFlexibleUNet/IDRiD-OpticDisc** folder,
and run the following bat file to evaluate TensorflowUNet model for IDRiD-OpticDisc.

```
./2.evaluate.bat
```

This bat file simply runs the following command.

```
python ../../../src/TensorflowUNetEvaluator.py ./train_eval_infer_aug.config
```

Evaluation console output:

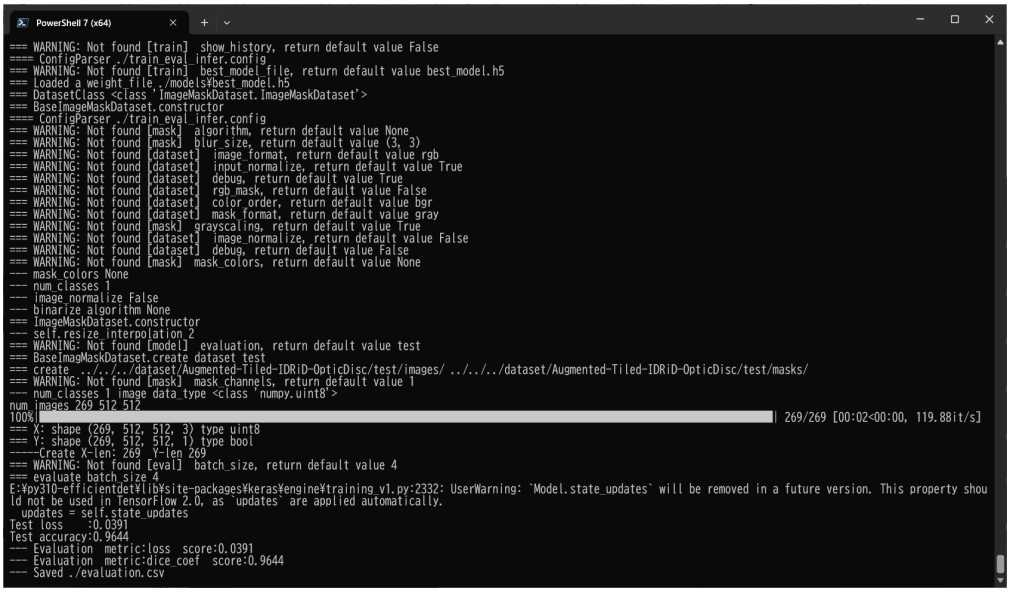


Image-Segmentation-IDRiD-OpticDisc [evaluation.csv](./evaluation.csv)
The loss (bce_dice_loss) to this IDRiD-OpticDisc/test was low, and dice_coef high as shown below.

```
loss,0.0391
dice_coef,0.9644
```

5 Tiled inference

Please move to a **./projects/TensorflowSlightlyFlexibleUNet/IDRiD-OpticDisc** folder
,and run the following bat file to infer segmentation regions for images by the Trained-TensorflowUNet model for IDRiD-OpticDisc.

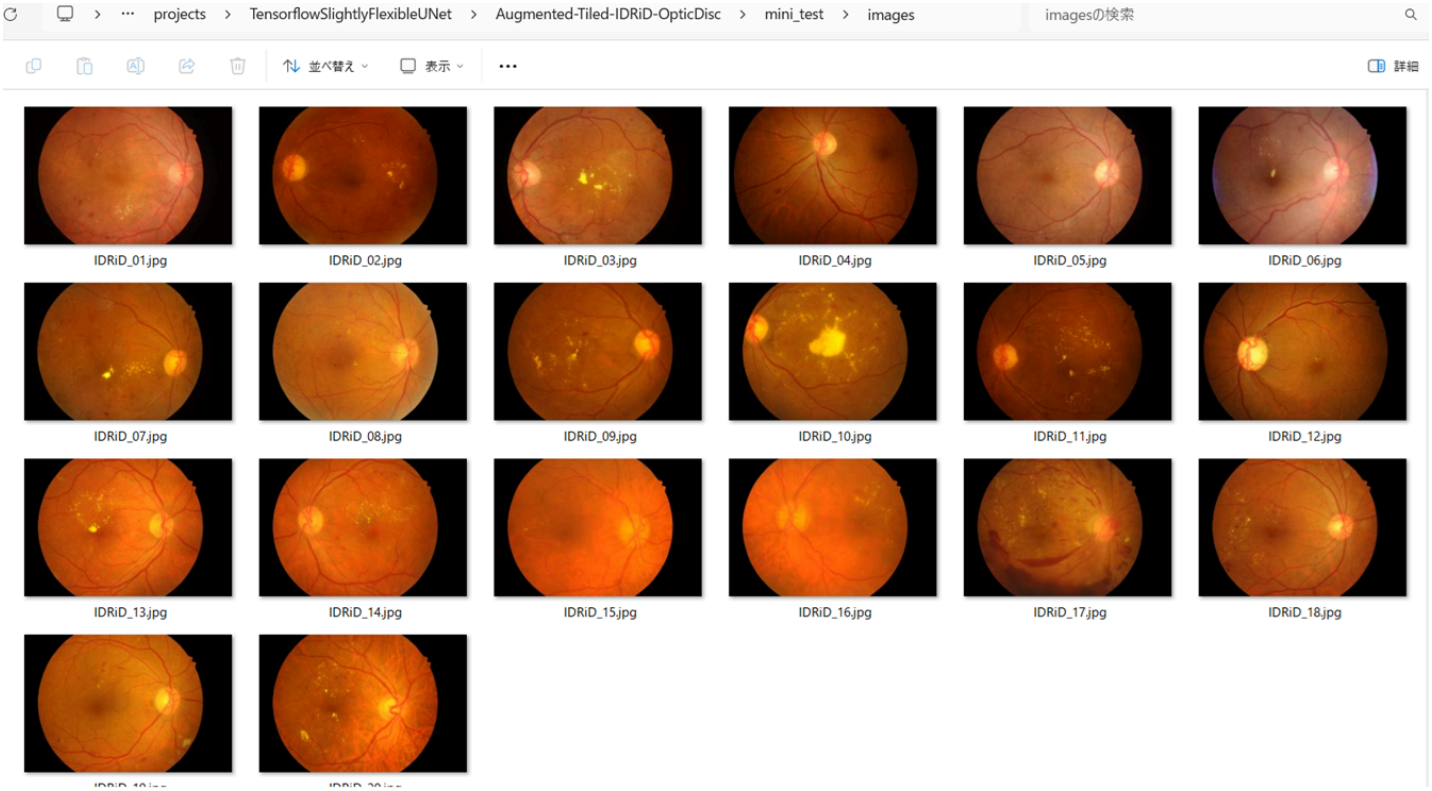
```
./4.tiled_infer.bat
```

This simply runs the following command.

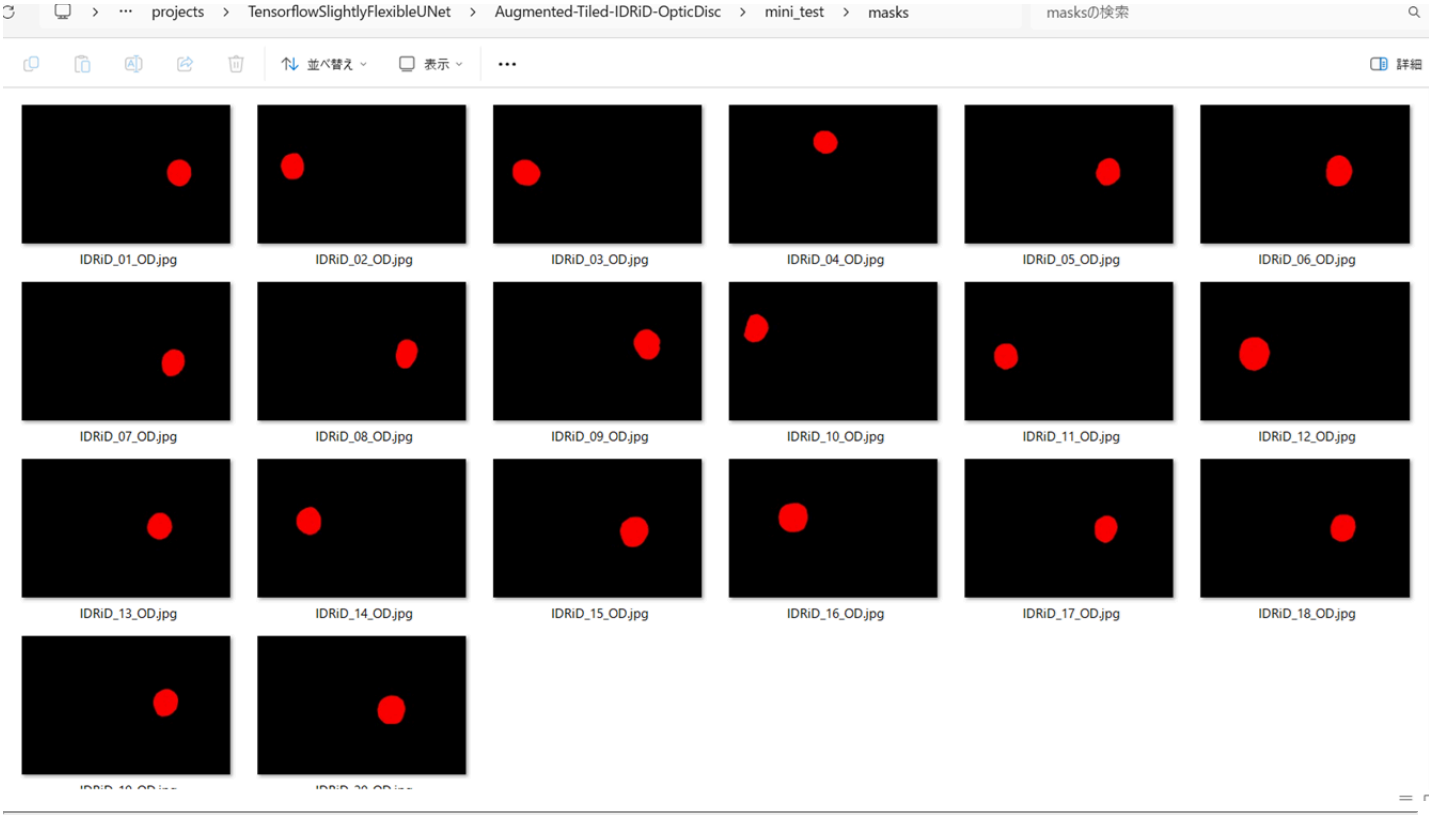
```
python ../../../src/TensorflowUNetTiledInferencer.py ./train_eval_infer.config
```

---

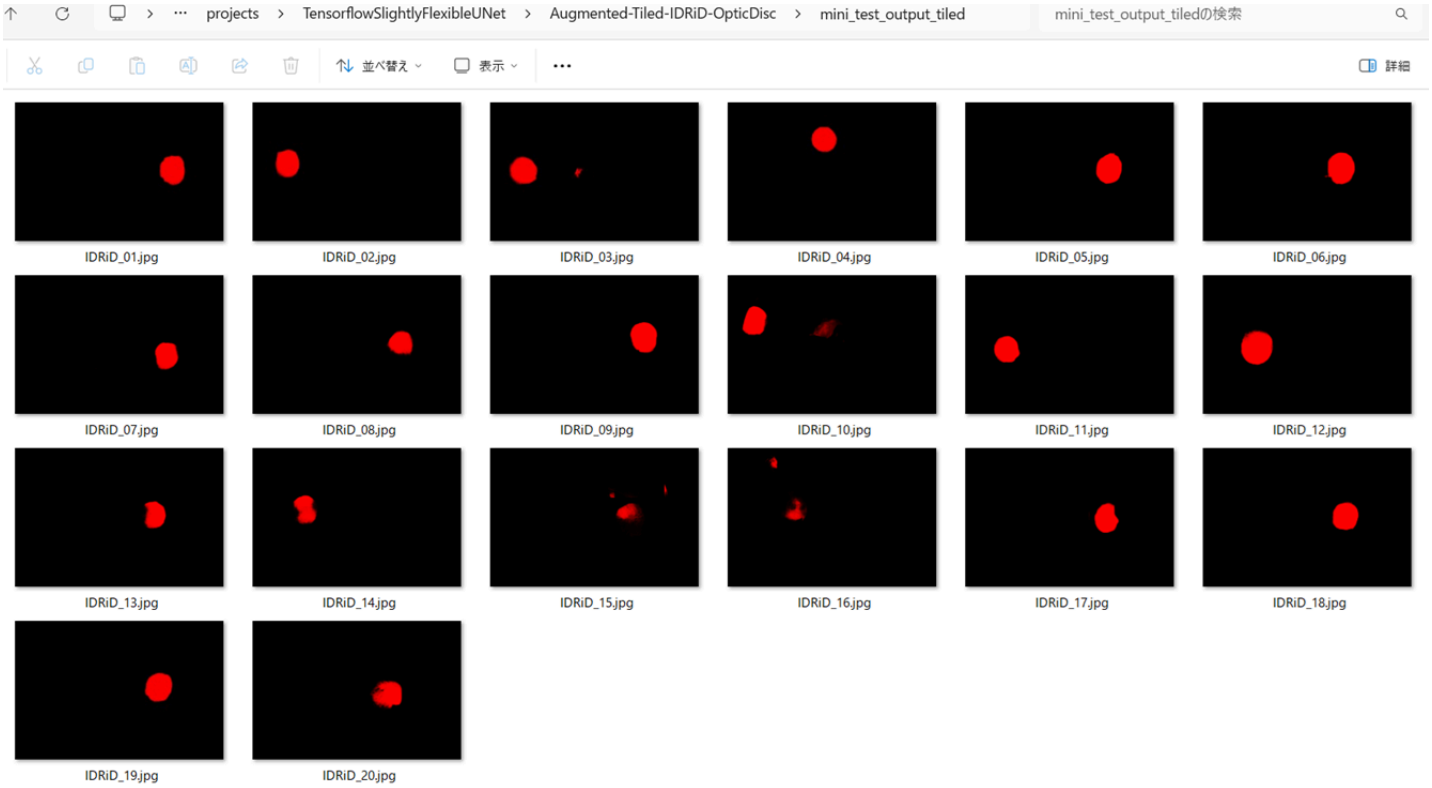
mini_test_images (4288x2848 pixels)



mini_test_mask(ground_truth)

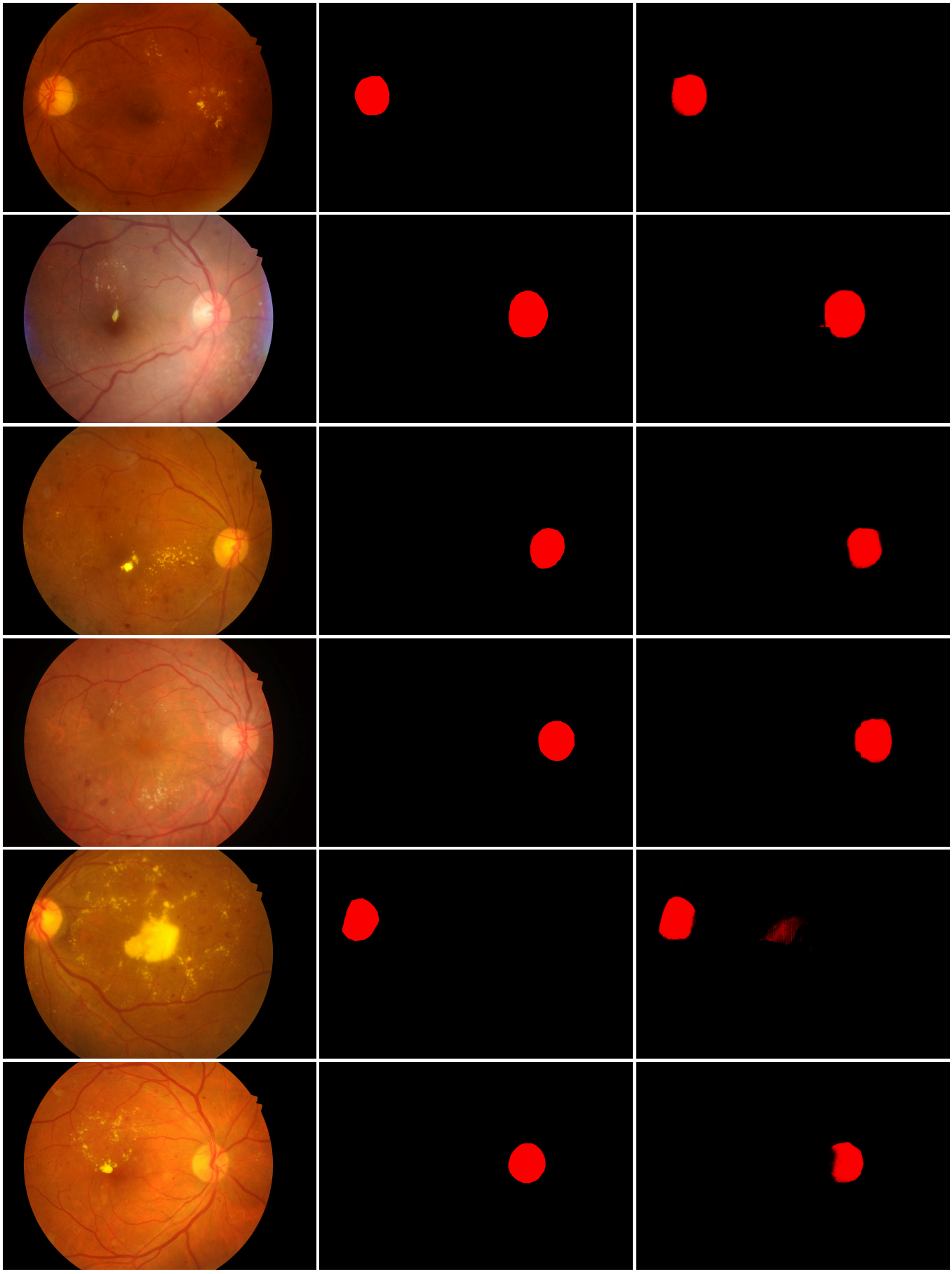


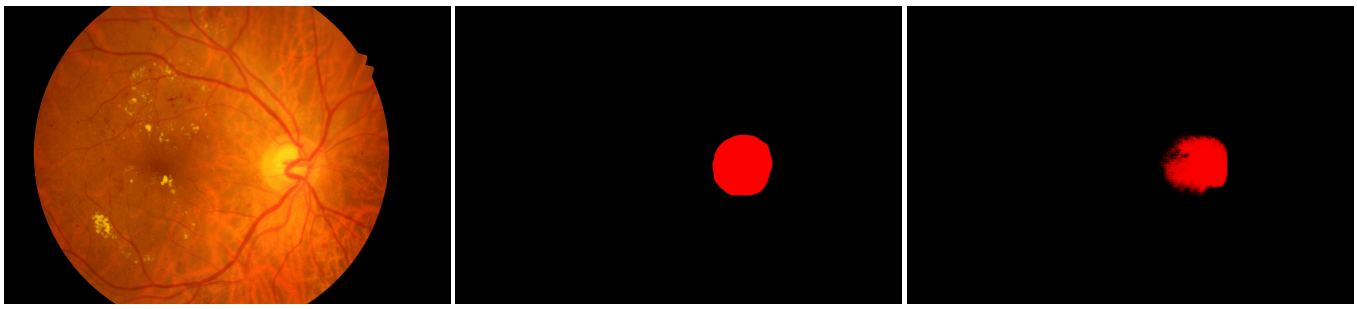
Tiled inferred test masks (4288x2848 pixels)



Enlarged images and masks of 4288x2848 pixels

Image	Mask (ground_truth)	Tiled-inferred-mask





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